Ontario

ENVIRONMENTAL ASSESSMENT BOARD

VOLUME: 73

DATE: Thursday, February 16th, 1989

BEFORE: M.I. JEFFERY, Q.C., Chairman

E. MARTEL, Member

A. KOVEN, Member

FOR HEARING UPDATES CALL (TOLL-FREE): 1-800-387-8810

EARR & ASSOCIATES REPORTING INC.

(416) 482-3277

2300 Yonge St., Suite 709, Toronto, Canada M4P 1E4

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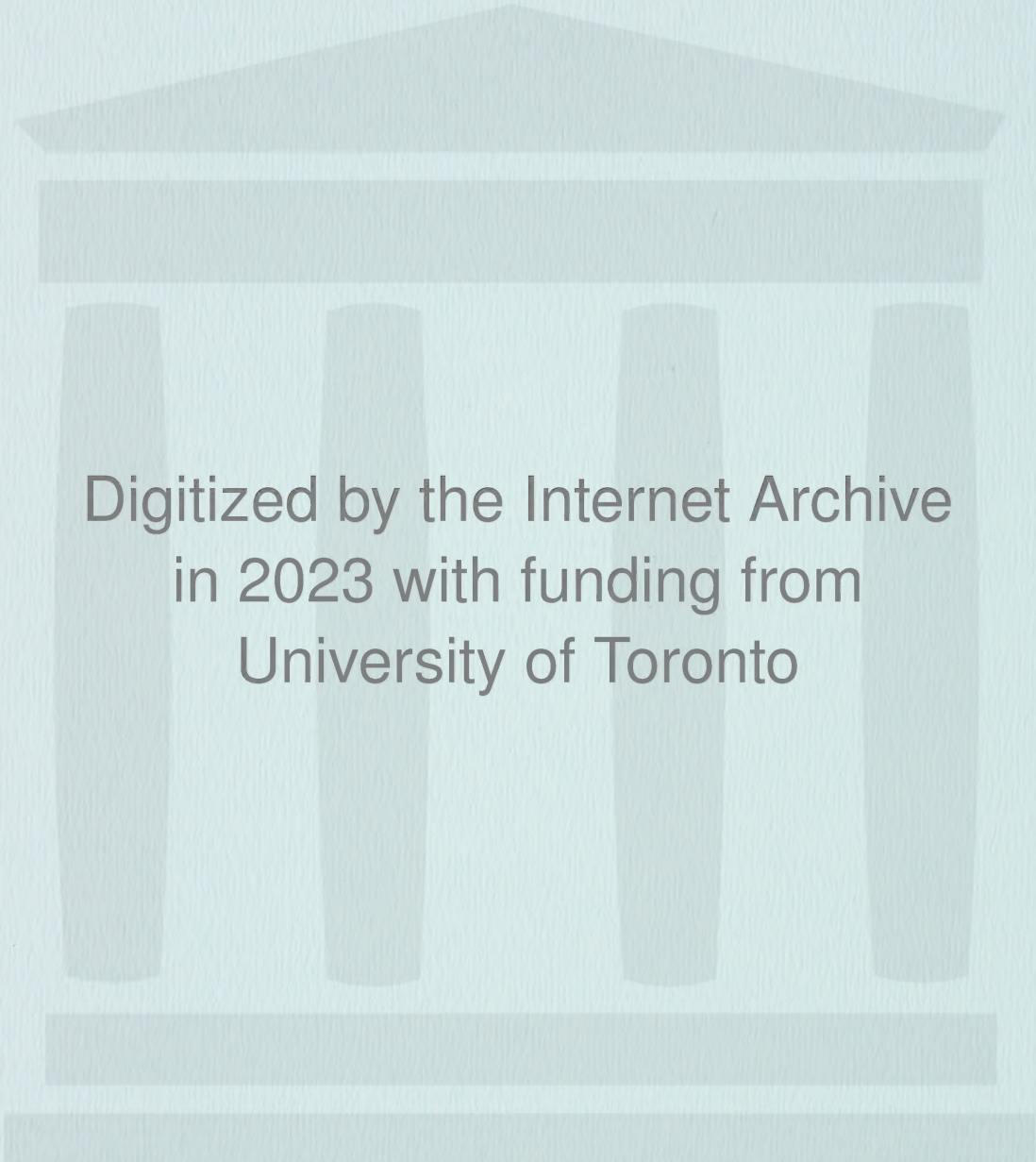

EA-87-02

HEARING ON THE PROPOSAL BY THE MINISTRY OF NATURAL RESOURCES FOR A CLASS ENVIRONMENTAL ASSESSMENT FOR TIMBER MANAGEMENT ON CROWN LANDS IN ONTARIO

IN THE MATTER of the Environmental Assessment Act, R.S.O. 1980, c.140;

- and -

IN THE MATTER of the Class Environmental Assessment for Timber Management on Crown Lands in Ontario;

- and -

IN THE MATTER of an Order-in-Council (O.C. 2449/87) authorizing the Environmental Assessment Board to administer a funding program, in connection with the environmental assessment hearing with respect to the Timber Management Class Environmental Assessment, and to distribute funds to qualified participants.

Hearing held at the Ramada Prince Arthur Hotel, 17 North Cumberland St., Thunder Bay, Ontario, on Thursday, February 16th, 1989, commencing at 8:30 a.m.

VOLUME 73

BEFORE:

MR. MICHAEL I. JEFFERY, Q.C.	Chairman
MR. ELIE MARTEL	Member
MRS. ANNE KOVEN	Member

A P P E A R A N C E S

MR. V. FREIDIN, Q.C.) MS. C. BLASTORAH) MS. K. MURPHY) MS. Y. HERSCHER)	MINISTRY OF NATURAL RESOURCES
MR. B. CAMPBELL) MS. J. SEABORN)	MINISTRY OF ENVIRONMENT
MR. R. TUER, Q.C.) MR. R. COSMAN) MS. E. CRONK) MR. P.R. CASSIDY)	ONTARIO FOREST INDUSTRY ASSOCIATION and ONTARIO LUMBER MANUFACTURERS' ASSOCIATION
MR. J. WILLIAMS, Q.C.	ONTARIO FEDERATION OF ANGLERS & HUNTERS
MR. D. HUNTER	NISHNAWBE-ASKI NATION and WINDIGO TRIBAL COUNCIL
MR. J.F. CASTRILLI) MS. M. SWENARCHUK) MR. R. LINDGREN)	FORESTS FOR TOMORROW
MR. P. SANFORD) MS. L. NICHOLLS) MR. D. WOOD)	KIMBERLY-CLARK OF CANADA LIMITED and SPRUCE FALLS POWER & PAPER COMPANY
MR. D. MacDONALD	ONTARIO FEDERATION OF LABOUR
MR. R. COTTON	BOISE CASCADE OF CANADA LTD.
MR. Y. GERVAIS) MR. R. BARNES)	ONTARIO TRAPPERS ASSOCIATION
MR. R. EDWARDS) MR. B. McKERCHER)	NORTHERN ONTARIO TOURIST OUTFITTERS ASSOCIATION
MR. L. GREENSPOON) MS. B. LLOYD)	NORTHWATCH

APPEARANCES: (Cont'd)

MR. J.W. ERICKSON, Q.C.) MR. B. BABCOCK)	RED LAKE-EAR FALLS JOINT MUNICIPAL COMMITTEE
MR. D. SCOTT) MR. J.S. TAYLOR)	NORTHWESTERN ONTARIO ASSOCIATED CHAMBERS OF COMMERCE
MR. J.W. HARBELL) MR. S.M. MAKUCH)	GREAT LAKES FOREST
MR. J. EBBS	ONTARIO PROFESSIONAL FORESTERS ASSOCIATION
MR. D. KING	VENTURE TOURISM ASSOCIATION OF ONTARIO
MR. D. COLBORNE	GRAND COUNCIL TREATY #3
MR. R. REILLY	ONTARIO METIS & ABORIGINAL ASSOCIATION
MR. H. GRAHAM	CANADIAN INSTITUTE OF FORESTRY (CENTRAL ONTARIO SECTION)
MR. G.J. KINLIN	DEPARTMENT OF JUSTICE
MR. S.J. STEPINAC	MINISTRY OF NORTHERN DEVELOPMENT & MINES
MR. M. COATES	ONTARIO FORESTRY ASSOCIATION
MR. P. ODORIZZI	BEARDMORE-LAKE NIPIGON WATCHDOG SOCIETY
MR. R.L. AXFORD	CANADIAN ASSOCIATION OF SINGLE INDUSTRY TOWNS
MR. M.O. EDWARDS	FORT FRANCES CHAMBER OF COMMERCE
MR. P.D. McCUTCHEON	GEORGE NIXON

APPEARANCES: (Cont'd)

MR. C. BRUNETTA	NORTHWESTERN ONTARIO TOURISM ASSOCIATION

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---Upon commencing at 8:30 a.m.

THE CHAIRMAN: Good morning, everyone. Please be seated.

Are you ready, Mr. Freidin?

MR. FREIDIN: Yes.

KENNETH ARMSON, Resumed

CONTINUED DIRECT EXAMINATION BY MR. FREIDIN:

Q. Mr. Armson, yesterday you had described four factors which influence the hydrologic cycle and you were dealing with the role of -- or the role that disturbance plays in changing the magnitude and, therefore, the influence of those factors and then, hence, the hydrologic cycle itself.

And the first factor you had described was the vegetative cover and I think we had almost gotten to the end of that.

So I just have a couple of questions to sort of wrap up that discussion about that one factor, and that is: In a summary way, can you indicate whether increased water yield is a positive or negative environmental effect when you are considering continued site productivity?

A. Well, it can be either positive or negative depending usually on the extent or magnitude of the yield.

Q. Can you just expand on that for me; give me an example of a positive effect, an example of a potentially negative effect?

A. Well, in certain instances one may wish to increase water yield and, by removing or controlling, limiting the amount of vegetation this is the way it could be done. That would be where water yield in itself is required.

I would say that that normally isn't the situation in the area of the undertaking. As a result of removal of vegetation there will be some increases, but as I indicated earlier, these are of a temporary or interim nature in terms of the forest conditions we are dealing with.

Q. Now, I would like to go back, Mr. Armson, and deal with some matters which were dealt with yesterday, perhaps just a few matters of clarification.

We were discussing yesterday the differences between forests in different parts of the world, and I asked you a question on the ability of forests in the area of the undertaking to recover and be productive after disturbance.

In your answer you referred to the fact that species in the area of the undertaking have

adapted to regrow after disturbance?

A. That is correct.

Q. Now, how is that information, the fact that these species have adapted to regrow after disturbance, how is that reflective of the productivity of the soils?

A. Well, the simple answer is that these species are productive on these soils following the disturbances that I have described and they have been productive over many centuries, if not thousands of years, and to our observation remain productive when we regenerate them by timber management.

Q. Okay, thank you. Now, Ms. Koven asked some questions about -- or asked a question about ash from a wild fire and whether in fact that ash would affect the canopy of surrounding forests?

A. Yes, I recall the question.

Q. In your answer you referred to the combination of precipitation, or the ash being carried over long distances when there is precipitation; this ash being deposited in water bodies, and you said: Like acid rain or having an effect like acid rain.

I just wanted to go back to that and say: Were you saying in your evidence that these wild fires were resulting in the addition of acid rain to the

waters that you referred to?

A. No, just the reverse because the ash was essentially containing bases. What I was referring to, it was in fact coming down not as an acid deposition but, in effect, as a low acid or basic deposition. I was using the analogy with precipitation, not necessarily acid.

Q. Okay, thank you. In answer to a question from the Chairman, you said that in certain situations you would consider not using full-tree harvesting.

Are there any absolute rules that you would follow or you would recommend be followed in this regard that would dictate the decision?

A. No.

Q. And could you explain why not?

A. Because, as I believe I indicated, the conditions under which a decision has to be made are only I think assessed or capable of being assessed appropriately by those who are on the -- responsible for the management and who can look at them.

If one, for example, were to have a fixed rule concerning depth, the question arises as to what is the variability, what proportion of the area and so on, and these are elements that only can be assessed

locally.

Q. And could you advise me what information a field forester would have upon which an informed decision in this regard could be made?

A. He would have a number of basis to make that decision. One, of course, would be his own knowledge and experience of the area. The other would be any available information, and we do have that for certain large areas of the province regarding the soils. A third would be aerial photographs, inspections that he might make or his staff might make in that area.

There is really any number of ways in which he would have that information and plus, as I have mentioned, his own knowledge of the situation.

Q. Thank you. I wasn't keeping notes yesterday, Mr. Greenwood was, and his notes indicate that you were asked whether there was movement of nutrients into the aquatic system without cutting.

I am not too sure who asked the question, I think it came to the Board. Anyway, the answer is recorded as no, and my question for you is: If Mr. Greenwood's notes are accurate, was your answer accurate?

A. No. And I must explain to the Board.

I believe the question was the effect of clearcutting on an increase in nutrients in the water flowing from that area, and the question then came, as I recollect: What would be the situation where it was uncut, natural. And I took it as: Would there be an increase, and the answer of course, there wouldn't be an increase, but would there be in fact a movement of nutrients from an uncut area. The answer is, of course, yes, there always is.

Q. I asked you a number of questions about acidification of soils and in response to some evidence you gave Ms. Swenarchuk asked for production of any studies that you had to support your answer.

Do you recall that?

A. Yes, I do.

Q. Now, the evidence you gave was in response to a question whether any studies regarding acidification of soils due to harvest existed, and you said the studies indicated that there had been increases and decreases and, in some places, it stayed the same.

The question I asked you was in relation to acidification of soil studies, and I understand that you want to go back and comment on your answer?

A. Yes, I would. The studies that we

use are not those which have directly measured pH values or acidity on soils in cut-over areas and uncut, there may be some, but to my knowledge there are very few studies and I can't think of one.

But what we do have are a fair number of studies, and certainly a number within this province and within the area of the undertaking, in which the acidity or changes in the acidity of water flowing from cut and uncut areas.

So there is a logic that says if there are hydrogen ions, acidity being increased in the soil and the soil water is moving out, there is an increased water yield, and that is documented, then a change in the level of acidity in the water should, therefore, reflect a change in the acidity in the soil from which the water is flowing.

The studies are - and there are four papers which I believe will be distributed - indicate that there are some changes but the changes are very minimal and, in fact in some instances, they are the reverse, they is somewhat less acidity but they are very, very variable and there is nothing in it that would lead one to any firm conclusion.

THE CHAIRMAN: Mr. Armson, does MNR ever look at investigations or studies of other agencies

that might be involved with soils, such as MOE with respect to landfill site applications, Hydro with respect to drillings that they may have done to support Hydro towers and things like that?

Like, there is a body of information around, it isn't necessarily MNR's own work.

MR. ARMSON: Well, Mr. Chairman, I can't speak to that, as to the -- I am sure the research scientists in the Ministry are aware of many studies. Whether in fact they are taking into account - and your point is - studies from areas that are not directly related to natural resources, per se, I can't speak to that.

THE CHAIRMAN: Okay.

MR. FREIDIN: Q. Mr. Armson, in your answer about this measurement of the water, you said that there was measurement, or information regarding the water leaving the site?

A. This was in the streamflow?

Q. Right. Well, that's what I am getting at. Where do you measure that? What do you mean when you say streamflow?

A. Well, this is in the water where the studies are made in watersheds and the water that is flowing through the particular watershed, and at

whatever point it is being measured - normally in the stream - there is a measurement there in relation to then the type of forest condition or disturbance that has occurred within that watershed.

MR. MARTEL: Do we have those studies?

MR. FREIDIN: We have those studies here. I will give them to you during the break, Ms. Swenarchuk.

Q. Ms. Koven asked you yesterday whether increase in water yield in the spring was problematic for farmers. Do you recall that?

A. Yes, I do.

Q. And you indicated yes. And could you just advise me: Why is water yield in the spring problematic for farmers?

A. Well, two reasons basically. I believe perhaps the reason that Ms. Koven -- one of the reasons would be in relation to flooding and spring runoff. That would be one in which there would be some erosion, surface erosion taking out some of the topsoil and carrying with it, undoubtedly, nutrients, and if there had been a fall seeded crop, might even -- some of the seeds or the seedlings.

The second reason, of course, is that in terms of working the land, the spring is a very

difficult time for a farmer because with a soil with a high moisture content the machinery and equipment cannot be used effectively, in fact, can do serious damage.

Q. Do foresters have the same problems as the farmer?

A. They do with respect to the use of equipment and machinery, particularly in the spring. I would say that the erosion and, as I indicated, with a forest floor erosion is not a normal type of situation in a managed forest.

THE CHAIRMAN: We are not talking about much in the way of conflict though; are we, in the area of the undertaking between farming and--

MR. ARMSON: No, not to my knowledge.

THE CHAIRMAN: --forestry operations?

MR FREIDIN: Q. And you indicated that foresters have problems in the spring with equipment, do they have that problem on all sites?

A. No, they have it particularly on certain kinds of soils, the finer-textured soils, the fine sands and silts, in fact, the same kind - and clays to a limited degree - the same kind of soils that farmers also have the more difficult situation.

Q. Okay. Now, yesterday Mr. Martel

asked you a question about whether forests stopped flooding and in part of your answer you said - and I think I have got your words down fairly accurately - where you insert a forest you can reduce the level of flooding.

I understand you want to go back and address that particular answer?

A. That remark and it was perhaps -- I should have then explained further. I was referring, Mr. Martel, to the areas again that we had been discussing, the areas in southern Ontario which had been cleared, there had been agriculture and has been considerable reforestation - I believe I was referring to red pine - and those are the areas where I was suggesting there was an insertion of a forest on a land that did not have a forest floor, it had been eroded, did not have organic covering.

And there, of course, as one knows from the conservation authority situation, planting of trees and installing new forests has been a major factor in minimizing flood.

Q. Could you advise --

A. I was not referring to the boreal forest or the area of the undertaking particularly.

Q. All right. Well, can you advise me

in forested lands in the area of the undertaking, does harvest affect flooding?

A. The evidence and the consensus is that it does not affect flooding. Flooding is -- the basic reason for flooding are exceptional and intensive storms and they will occur whether or not there is a forest. And I believe I also spoke in response to a question by Mr. Martel and said that there are floods in undisturbed forests or natural forests, and these occur because of the intensity of storm.

Q. The last matter directly arising from yesterday's answers, could you -- I understand you would like to go back and comment on your evidence in relation to the desynchronization of snow melt?

A. Mr. Chairman, the desynchronization term is not one that I would particularly subscribe to, and perhaps in my explanation of the effects of vegetation and the different kinds of vegetation I referred to conifers as compared with hardwood trees in terms of the amount of the snow melt, I referred to the aspect and so on.

I perhaps should have elaborated further that where there are openings as caused by cutting, particularly clearcutting, the normal pattern is for the snow to melt earlier there rather than it would if

there had been a forest cover.

And so the effect in an area of snow melt where you have a pattern or a combination of both openings and full cover vegetation, depending on the type, is to in fact more or less meter out the water. The snow melt comes earlier than it would if it were all forested, so that melts. And so you get sort of a -- although there is a major amount of water, it is spread -- the flow of that water is spread over a longer period of time. And this is what is referred to as desynchronization.

THE CHAIRMAN: What does the term itself mean? Does it just refer to the fact that snow melt occurs in a different timeframe than it normally would?

MR. ARMSON: That is essentially the meaning of the term. It spaces out the melting of the snow.

MR. FREIDIN: Q. Okay. If we can go back to our discussion of the various factors affecting the hydrologic cycle.

The second one was soil condition, and in your earlier evidence you indicated that harvest has the potential to affect soil conditions. If that potential becomes actual, does it have any effect on the hydrologic cycle?

A. Yes. The immediate effect, of course, of harvest on soil conditions would be to take away the major manner in which water is being removed from the soil during the growing season, pumped back into the atmosphere as evapotranspiration.

So the immediate effect then of removing the vegetation or forest is to increase the soil water content. That is the first and usually very immediate feature.

Q. Is surface runoff a common result of harvesting activities?

A. Surface runoff is not a common occurrence because, as I indicated before, both the residual vegetation and the forest floor to a very large degree preclude that.

Q. Are there situations where you could have disturbance of the forest floor but still no unacceptable erosion will occur?

A. From harvesting?

Q. Yes.

A. If the operations, harvesting operations are in the frost-free period, and with the kinds of machinery that are used, it is normal to have the forest floor disturbed to varying degrees. Normally it is in the form of it being ruptured by the

tracks of vehicles and these can in fact cause a disturbance.

But where they are not -- where it is not a disturbance which removes, if you like, in a solid piece the forest floor and channels, there is normally no detrimental effect in terms of increasing runoff. Most of the disturbance is a breaking of the forest floor rather than a removal of it by such machinery.

MR. MARTEL: When you are pulling out the logs, though, is there not a possibility that you would create a rut that could create problems?

MR. ARMSON: Yes. In certain soils it could create a rut and, particularly depending on the moisture content, but normally the effect of logs -- often in summer operations that can be an advantage in terms of disturbing the soil, almost a type of site preparation, although it is related to harvesting and that has often been part of a prescription for summer logging. So that you get a disturbance of the soil, a breaking up of the forest floor, but it isn't actually plowed away in any way.

There may be some rutting in it but, as I indicated, the ruts -- unless you were really building a road - and I am not referring to roads in any way here at all, that's obviously a different situation -

but normally they are not in a fashion that they lead to channelled erosion.

MR. MARTEL: They would move then--

MR. ARMSON: They would be moving...

MR. MARTEL: Rather than keep coming the same -- following the same path, they would in fact --

MR. ARMSON: That is correct. And in fact there are -- I am aware of certain operations where those very specific instructions have been given to the skidder operators to in fact move in different pathways.

MR. FREIDIN: Mr. Greenwood will be addressing that specific topic in Panel 10, Mr. Martel.

MR. MARTEL: Thank you.

MR. FREIDIN: Q. Mr. Armson, can areas with exposed rocky surfaces be harvested with an acceptable increase in surface runoff?

A. Well, if they are exposed rocky surfaces, I doubt that there would be any harvesting going on.

Where there is a very minimal amount of organic material, very minimal amount, and there may be some commercially-sized tree, I think in that situation one would be very careful to use equipment to destroy the surface organic layers. I think this is the type

of situation you are referring to.

Q. What about the cutting or felling of trees; can that on its own have an effect on surface runoff?

A. Not directly, only in terms of changing the soil moisture supply.

Q. As surface runoff does occur, are there potential negative effects on site productivity?

A. If it does occur, yes.

Q. And can increased runoff have any effect on nutrient removal from the site?

A. Yes, because nutrients can be removed both in solution in the water that is running -- surface runoff, but probably more particularly in terms of the particulate matter, the small particles that would be eroded with that surface runoff.

Q. Is phosphorous a nutrient which could leave the site in that fashion?

A. Yes, it is probably one of the major nutrients that would leave the site. I think it is generally recognized, not only in forest soils but also in agricultural soils, that phosphorous is one of the major components in runoff material.

Q. I would now like to ask you a few questions on another factor affecting the hydrologic

cycle and that is water table that you referred to.

A. Yes.

THE CHAIRMAN: Just one moment, Mr. Freidin. Mr. Armson, where you said that if there is runoff it may have a detrimental effect on productivity, are there not cases, however, that you would want runoff in terms of making sure that some acquifers and streams and whatnot received the appropriate amount of water, otherwise streams would dry up and things like that?

MR. ARMSON: Yes, Mr. Chairman. I am aware that -- I believe that the water supply for the City of Liverpool in England comes mainly from mooreland areas in Northern Wales and the Forestry Commission over the period of the 1930s and into the 1940s and 50s planted up much of the watershed.

And it is my recollection some years ago that there was considerable concern because the water yield from those areas began to very significantly diminish and they quickly realized the problem was that they had reforested an area and they had reduced the water yield coming off and that was not what the purpose of that watershed was.

So, you are quite right, you may want in fact to maintain areas with a relatively high amount of

runoff or subsurface runoff, both ways.

MR. FREIDIN: Q. Following along from that, Mr. Armson, when you said that surface runoff had the potential to affect adversely site productivity, what is it that happens that could cause a reduction in productivity?

A. Well, what happens -- if you have surface runoff and material being carried away, nutrients, then you are removing some of the nutrient pool, particularly from the surface layers, and you may in fact also be removing some of the physical upper part of the soil that carried the nutrients.

That's the manner in which I am referring to reduce productivity.

Q. And what do you call that when in fact you are removing some of the soil material itself?

A. It is being eroded.

Q. All right. Now, going then back to water table. The evidence which has been filed indicates that harvest has the potential to affect the elevation of the water table.

Can you advise me: Is it common to find a rise in the elevation of water table due to harvesting?

A. No, it is not common.

Q. Are there certain site conditions which provide the potential for a rise in the water table which is noticeable at or near the surface?

A. Yes, there are conditions and I would refer to the Panel 9 statement of evidence and Figure 8 which illustrates a situation where, following harvesting, and I have an overhead of that particular figure.

Q. Okay. Page 34.

A. The figure is a diagram illustrating the effect of change in forest cover and related evapotranspiration on the depths of the water table where in fact there is no lateral movement.

This would be the type of situation that would occur in a basin or in a depression where the water is accumulating and, in fact, over the period the water table will fluctuate but over the seasonal period the root systems of the trees are in fact drawing water from the water table, either directly at that surface or more likely just above it.

So that when the, if you like, pumps are no longer there, then what is recorded would be a rise in the water table.

This is the situation that probably is common -- thought of as more commonly occurring. It

actually is a more uncommon situation where we have water tables that are well below the level of the root systems. Even when you harvest they won't change the depth of the water table.

The more common situation - and this is shown on page 35, Figure 9 -- on page 36, Figure 9 - and this is a situation that is quite common, particularly in the Clay Belt area of the undertaking, is where there is a water table within the zone or just below the zone of rooting, but in this instance because of particularly the materials and the slope, the water is actually moving.

And I referred to this yesterday as often as a situation that is analogous to somewhat of a hydroponic, but the water is moving and the rate of water movement -- the important point here is the rate of water movement. In this instance, when we cut the stand, there is no change in the water table level and it signifies that the rate of lateral movement is in effect greater than that of the evapotranspiration.

So that when we remove the pumps it is not having any significant effect on the flow. So we are dealing with a rate situation here rather than something that is static.

Q. All right. In distinction to water

table rise, I would like to ask a couple of questions about accumulated water at the surface. I am just wondering, are there any conditions following harvest -- conditions that might occur that have the potential for resulting in noticeable accumulated water at the surface?

A. The only way in which that would occur would be if the rate of infiltration was such that the intensity of precipitation coming to the surface was greater -- in other words, the amount of water coming on to the surface was greater than the rate of infiltration, then there would be in fact an accumulation of water at the surface.

This does sometimes happen in forested conditions because of the high intensity of rainfall, but it usually is very local and of a short duration.

Q. If mitigated actions are not taken, are there any conditions which could be caused by equipment which might result in the accumulated water at the surface?

A. Yes. If there were significant compaction by equipment on a soil, then this would in effect reduce the capacity of the soil to have water enter it, reduce the infiltration rate, that could result then in an accumulation if that did occur.

Q. And Mr. Martel had asked you a question about rutting. If that occurred, could that have the result we are discussing?

A. Yes, that would result in not only some compaction but providing in effect an hollower basin or an area for the water to collect.

Q. All right.

MR. FREIDIN: Again, those mitigative measures will be addressed by Mr. Greenwood in Panel 10.

Q. Road construction, can that have any play in terms of accumulated water at the surface?

A. Yes, I believe road construction - and that's not my area of expertise - but certainly all the evidence and discussions and so on seem to put a great deal of discussion on the effects of road -- particularly during construction, as well as the roads afterwards.

MR. FREIDIN: Right. And that will be addressed by Panel 14, Mr. Chairman.

Q. Are the effects of water at the surface either because of a rise in the water table or through these other possible means; rutting, compaction or road construction, are they detrimental to the forest estate and, if so, perhaps you could explain

why?

A. Well, they can be detrimental locally in that they can both create situations of saturation where there were existing root systems of trees and other vegetation, and once they are in a saturated water state then the roots will normally die and locally that can cause some mortality and death.

THE CHAIRMAN: Mr. Armson, when you take a look at some lakes, and I guess rivers as well, streams and you see trees of fairly decent sizes growing right next to them with some of their roots looking like they are in the water or underground so that they would be saturated so to speak, how do they keep alive?

MR. ARMSON: Well, Mr. Chairman, that is a lateral movement of groundwater. In effect, that streamflow, you are quite right, the largest white spruce normally are found down on the -- towards the lower elevation by streams.

That is exactly the situation I was describing here although I wasn't describing it for a stream, more for a more general area, but that is exactly it. It is almost -- as I say, it is hydroponics virtually. The water is carried dissolved oxygen, dissolved nutrients, but it is moving and the

root systems of many species can survive in water as long as there is dissolved oxygen.

THE CHAIRMAN: Oh, I see. So it is the fact that there is oxygen in the water...

MR. ARMSON: That's right, if you stopped up that flow.

THE CHAIRMAN: Right.

MR. ARMSON: And maintained the water level the same but kept the flow, then I can assure you the roots would die.

THE CHAIRMAN: Thank you.

MR. FREIDIN: Q. Now, you indicated that it was not common to have sites where the water table would rise to the surface?

A. That is correct.

Q. Right. Are the sites which are susceptible either to that effect -- are there any other areas in the province where there is a higher possibility of that occurring than others?

A. I think the area that one would look for would be in the Clay Belt area in terms of a large area of the forest which characteristically has a high water table in any event. What we -- as I say, we do find there, we do find pockets and we do find situations where the water table is close to the

surface, in fact much of it. But, as I indicated, much of that area of that water table, or the water, as represented by the water table, is in fact moving.

Q. Okay. You have addressed the question of harvest and the potential effect that has in terms of water yield -- pardon me, water table and accumulated surface water. Do any of the other timber management activities affect water table or accumulated surface water?

A. To a very limited degree. Most of them would have a negligible effect; site preparation for example, and only then to the degree that it might destroy or remove vegetation. But that normally isn't the purpose of most site preparation. Prescribed burning, of course, would but there there is usually an active regrowth.

I believe that the activities of site preparation; tending, there is some possibility there of improving soil moisture or increasing soil moisture, but the effects in terms of water table would be, in my opinion, negligible.

Q. All right. And the effects in terms of accumulation of water at the surface?

A. It would be negligible, very minor, if at all.

Q. Thank you. Could the effects of harvest, site preparation and tending or thinning on the hydrologic cycle be quantified or compared to the effects which would be caused by natural disturbance?

A. Yes, there is -- as I have indicated, harvesting is a removal of the active transpiring component; natural fires would do that and so, of course, would an area of windblown forest, it removes those pumps.

In terms of thinning, there are natural causes that bring about thinning and mortality in a stand; both insects and disease more, particularly disease. So there is an analogous situation there. But I don't think in any of those situations are you dealing with levels that would be of any considerable significance in terms of water table level.

Q. I would like to ask you a couple of questions which arise out of the scoping session, again, questions or issues posed by the Ministry of the Environment.

The first question is a question or issue they identified arising out of paragraph 26 of your evidence.

MS. SWENARCHUK: What page?

MR. FREIDIN: I am sorry it is an issue

for Panel 10, that is the problem. There are times when I have second thoughts about combining 10 and 9, Mr. Chairman.

As re: the scoping session, I can't find my Panel 9 executive summary. I won't ask for yours, Ms. Koven.

Q. All right. So we are talking there in paragraph 26 about water yields and duration of water yield effects. Ministry of the Environment asked:

> "Given that site preparation activities such as prescribed burns and herbicide applications alter the rate and quantity of revegetation, is it appropriate to conclude that, in general, water yield from a harvested site will drop off rapidly?"

That was their question. I can repeat it if you wish.

A. If you would, please, because I don't have that. Is it paragraph 26 on page 1 of the Panel 10?

Q. Right.

A. This is in the original. Yes, I have read the paragraph 26.

Q. Okay. Their question was:

"Given that site preparation activities such as prescribed burns and herbicide applications alter the rate and quantity of revegetation, is it appropriate to conclude that, in general, water yield from a harvested site will drop off rapidly?"

A. Well, to the degree -- when the harvesting takes place there will be an increase in water yield. If there is a site preparation treatment subsequent to harvesting which then removes for a period of a year or so the established vegetation, as a prescribed burn might do, then the water yield will remain up; in other words, there isn't an evapotranspiring surface there, so that will remain up for a longer period than if it was harvested and some form of mechanical site preparation which didn't, in effect, destroy the lesser vegetation were employed.

That I believe is the way I would interpret the -- give my answer to what seems to be the question there.

Q. What reduces the water yield after harvest?

A. The revegetation. So that any revegetation, and normally that would be considerable

following a prescribed burn or from whatever other activity, then that would reduce the water yield over time.

Q. How long does that revegetation normally take?

A. Well, if a prescribed burn is done in the early or mid-summer there is normally some revegetation during that same year and certainly within the next season there is usually a very considerable revegetation, including - since this is site preparation for regeneration, including regeneration from planting that is being done.

Q. Okay, thank you.

MS. SWENARCHUK: Would you mind repeating that last sentence, I didn't hear it, regarding site preparation.

MR. ARMSON: Well, following site preparation, the site preparation is done presumably to prepare the area for regeneration. If that regeneration is planting, and that is very commonly the case after prescribed burning, then there would be in fact a revegetation of the trees to start with, but there would also be other vegetation naturally occurring there.

MR. FREIDIN: Q. Turn to paragraph 28 of

the Panel 10 executive summary. Do you have that one?

A. Yes, I have that one.

Q. Let's try approaching this this way. Let's read that one before I ask you the question:

"Reduced evapotranspiration from reduced forest canopy cover can result in increased soil moisture or under certain well-defined conditions, water accumulation at or near the soil surface. The magnitude of such changes are normally within the limits reached through climatic fluctuations and natural disturbances of evapotranspiration. Exceptions include unusual restrictions of drainage due to soil rutting or compaction during mechanized operations."

Ministry of the Environment wanted to know whether the database currently available to MNR was adequate to support the proposition that -- and they repeated what you got have here:

"...that the magnitude of such changes, water table rise, are normally within the limits reached through climatic fluctuations and natural disturbances of evapotranspiration?"

Do you understand the question?

A. Yes, I understand that question.

Q. All right.

A. I believe the database, plus our understanding of the hydrologic cycle and how it is affected from both general studies and over time give us a very considerable knowledge of how we may alter or, in our timber management activities, carry out certain practices which will affect the water yield and the hydrologic cycle.

I believe that that in itself constitutes a very large array of both data -- individual data, knowledge from observation, and also the application of some pretty well-founded principles concerning the cycle.

Q. All right. You said that that in itself constitutes data. You are referring to what then when you said...

A. There are data, there are studies, for example, concerning the effects of harvesting activities on water cycles.

So we know that there have been studies, not necessarily in Ontario, that have looked at other types of practices. So that they have provided data, but we also have I believe an understanding of the

hydrologic cycle and the factors that affect it and can interpret those to a local situation.

Q. Do you -- are you equating data to knowledge in your answer?

A. Considerable knowledge and some of that is quantitative, yes.

Q. Thank you. Now, paragraph 29 of Panel No. 10 states:

"Currently no Ontario documentation of reduced growth due to compaction..."

Hold on a second. Why don't we just forget the paragraph that it might be in relation to.

I will ask you this question: Can you advise how nitrates are formed and how they move through the soil?

A. Nitrates are formed in soils as a result of a process called nitrification in which the nitrogen in combined form, for example, in the form of plant proteins forms a substrait or food source for certain bacteria which converted initially in the normal sequence of events to ammonia nitrogen and there are another group of bacteria which then take that ammonia and convert it into nitrate nitrogen.

The important thing here is that the ammonia producers are organisms which have a certain

range of tolerance in terms of the conditions in which they operate, the ammonium ion - ammonia form of nitrogen, can be held in the soil in an available sense and it can be absorbed by many plants, particularly by forest trees as a nitrogen source.

So, in other words, if there is ammonification, as we say, of a complex nitrogen source as in the forest floor, then that can provide nitrogen to the vegetation, particularly the tree vegetation in certain soils, particularly those soils characteristic of south of the area of the undertaking where the soils are either neutral or slightly alkaline - they are certainly not very acid soils - then the other bacteria the nitrification bacteria which convert the ammonia to nitrate take that ammonia, convert it to nitrate and that nitrate is then released into the soil and that is a very mobile form of nitrogen and can be moved in the soil solution and, of course, can move through the soil and ultimately out into the water in streamflow and in lakes.

Q. The nitrogen in the area of the undertaking, not the areas that you just referred to now, are they in a mobile form?

A. The nitrogen that is produced in soils as a result of biological -- microbiological

processes within the area of the undertaking -- as I indicated, the soils in the area of the undertaking are, for the very most part, vast majority are acid and in the forest floor particularly those -- the organic layers are quite acid, they have values which, for the most part, are not those within which the nitrate forming bacteria can operate.

There have been some studies of this. One study in particular that was carried out in the Great Lakes/St. Lawrence area, rather than the boreal, which is even usually more acid conditions and no nitrification in terms of nitrate production was found in those soils.

The study was carried out by microbiologists from the University of Guelph some few years ago and they then undertook to determine what would bring about nitrate formation in those acid soils.

They used applications of lime to make the soil less acid, and they used applications of phosphatic fertilizers and that was the only way they could bring about nitrate formation in those soils. These were hardwood maple soils incidentally they were not conifer soils.

Q. Thank you. I think that is the

evidence in relation to the hydrologic cycle and perhaps we could move on to an area which is going to deal with soils again, but a little different emphasis.

In previous evidence, Mr. Armson, the topic of soil has been a recurring one and I understand that you have put together a number of slides which you believe will provide information to the Board which will be helpful, not only in terms of understanding general principles, but helpful in later panels?

A. Yes, I have.

Q. And before you do that, I would just like to ask you a couple of questions. What would your response be to a statement: that thick soils are always less susceptible to environmental damage than thin soils?

A. Well, the question here centers around by, what do you mean by thick, what do you mean by thin? And I think that is a key factor and that is one of the reasons why I believe that it is important to understand some of the physical nature of soils and what a soil is from the standpoint of, first of all, a soil scientist and what it is in perhaps a more general perception of it.

Q. Okay. Is this a subject matter that your paper in Panel No. 9 addresses? Is it something

that you have...

A. Yes, it is. On page 38 of the evidence in Panel 9 and, particularly then on pages 39 and over to page 40 and 41 -- those I believe from pages 38 through to -- well, actually even beyond that, to 42 -- pages 38 to 42 deal with many of the principles relating to soil depth or thickness but there are no visual examples and I thought for this reason, Mr. Chairman, it might be useful to provide the Board with them.

Q. Would it be fair, Mr. Armson, to state that your paper -- that you have chosen to highlight this particular matter in your paper?

A. Yes, I have, because in my experience this is an area concerning thickness or thinness of soils where there is considerable both misunderstanding and perhaps where the perceptions of what thickness or thinness may mean in terms of both nutrients and certainly in terms of the hydrologic cycle, and also in terms of productivity of the forest itself, there are some considerable areas here, I believe, of misunderstanding.

Q. I understand that your photographs are intended in part to address those misunderstandings?

A. That is correct.

Q. When you are looking at a site or considering site characteristics, if you use the term that an area is susceptible to environmental damage, what would you be speaking about?

A. I would be speaking very specifically then of particular properties of the soil in relation to some very specific aspect of the environment in terms of water or erosion, water yield and so on. I would not be speaking - and I don't think it is possible to speak - in general terms about that.

Q. Okay. Well, perhaps we can turn those slides on.

MR. FREIDIN: Now, Mr. Chairman, if I just might indicate that I think the way that these photographs are going to be dealt with, I am going to ask Mr. Armson in relation to each of these photographs - if he sort of doesn't do it on his own - what information is conveyed in the photograph, and I am going to also be asking him to advise whether the information conveyed through observing the conditions depicted in the various photographs would be useful to a field forester in making silvicultural decisions.

THE CHAIRMAN: How are you going to deal with these slides as far as...

MR. FREIDIN: We have a hard copy. (handed)

THE CHAIRMAN: Do you want them going in as one number with alphabetical references to each slide, or how do you want them marked?

MR. FREIDIN: Sure, I think that is a good way, keep the same number.

THE CHAIRMAN: Okay. Exhibit 418. The first one will be 418A and just go down the...

MR. FREIDIN: And if all has gone as planned, they will be in order, Mr. Chairman.

If I may, Mr. Chairman, the first two slides deal with aspects of the forest floor. I think I have referred to it, there has been considerable discussion. I felt it perhaps important to illustrate a kind of forest floor which occurs within the area of the undertaking, a very common one.

---EXHIBIT NO. 418A: Photograph of area in Algonquin region depicting aspects of forest floor and fertility levels.

MR. ARMSON: This, as you can see from the photograph perhaps here, they are predominantly maple foliage, this is the Algonquin region, a region I believe the Board visited late last year. And what it is in the photograph is a vertical section into the

soil showing the litter layer. There is a six-inch rule stuck into the forest floor and what you have is the uppermost part of the litter layer. This was a photograph taken in the late spring or very early summer, so the foliage you have there is from the previous fall.

What you then have is a somewhat darkened area in here which has been flipped up, which is holding together, and this is where there is some partial decomposition. What is holding it together actually is a network of fungi which are feeding on it, and then beneath that there is a darker brown layer and then there is sort of a blackish and almost a salt-and-pepper coloured layer. The salt-and-pepper layer, the light colour here, I think you can see that, is the uppermost zone of the mineral soil.

So the forest floor here is relatively thin and the ruler which is in inches is stuck into it and it is approximately two inches thick. That is the organic surface covering.

And it is over a soil, which you can't tell from the slide, but I can assure you is a sandy loam in texture and you can see the tree roots are in here. The stand that was taken was, as I say, a hard maple forest.

Now, in looking at that slide, we first of all recognize that this is not a young maple stand - you have to take that - this was an older one. So that we have actually a forest floor that is not thick and there has not been -- if you consider the annual accumulation, we find that the years' litter from the previous year will be going through a decomposition process, a slow one and, in fact, there is a period of several years before the litter is then transformed into essentially humus, or organic amorphous material.

In looking at that, coming back to this: what would a forester see if he just flipped that over, that would tell him this stand, which is an older -- it is quite an older stand, that the rate of decomposition is relatively rapid -- it is not very rapid, but it is relatively rapid, so that in all likelihood this is a relatively fertile soil and indeed it is. It is not -- it is an acid soil - this is from the same area that I mentioned, there is no production of nitrates - this is quite an acid condition, yet there is a relatively rapid turnover of the organic material.

The forest floor, therefore, is relatively thin, but it is keeping the nutrient level up.

MR. MARTEL: How do you make that jump,

Mr. Armson, from saying it decomposes quickly and, therefore, we know it is a fertile...

MR. ARMSON: Because our knowledge of what happens in decomposition of organic material and we know that there is a large body of nutrients in the foliage, in the litter. And when that decomposes to the humus here, there is a transformation and the nutrients in that are released both into the decomposing organisms which then in turn die, there is a whole -- very complex chain reaction.

MR. MARTEL: But the reason I ask that is in the forests of South America, for example, the foliage comes down but in fact it is not a fertile soil; is it, in most rain forests?

MR. ARMSON: Well, in the situation where the foliage comes down and decomposes very rapidly, maybe even partially decomposes before it hits the ground, that is -- with that continual cycling, rapid cycling that is a fertile situation, but the fertility is in a constant state of -- as soon as it is released it is taken up again. Here there is a holding mechanism.

MR. MARTEL: Okay.

MR. ARMSON: Okay. And in fact the next slide, Mr. Martel, will illustrate something close to

that.

As I say, the key observation here is that the litter layer is in tact, it is not a thick one, you would not want to remove it, and you know that it is maintaining your fertility level. The roots -- there are many fine roots that doesn't show in the slide here, both here and in the upper most part of the mineral soil.

As I say, the first two slides speak particularly to the forest floor and the fertility level, and I am not going to address the matter of erosion or water yield in these two slides.

MR. FREIDIN: Q. Mr. Armson, as you go through here, if what you are indicating or the observations you are making and the conclusions that you could draw from those observations, if you feel that the observations that you are making are only able to be made by you as opposed to a field forester because you have special expertise, I want you to point that out.

A. Well, in the previous slide, for example, I would suggest that a forester, professional forester would look at that and perceive that thickness or thinness and the degree to which there is decomposition and would, in fact, come to the same

conclusion that I am coming to without perhaps going into some of the technical aspects of it.

Q. All right. And so perhaps we will just proceed on the basis that the observations, conclusions would be similar, but if you are making sort of added things which -- you know, observations or conclusions that they wouldn't perhaps describe it quite the same way, I want you to point that difference out.

THE CHAIRMAN: Mr. Freidin, isn't that somewhat speculative as to what somebody else, even with a certain amount of background, would think? I mean, Mr. Armson himself is a forester, but he also has a lot of additional experience.

MR. FREIDIN: I think that Mr. Armson - and you perhaps could ask him - as a former professor could at least indicate what general knowledge a professional forester would have, and we are talking here about professional foresters, we are not just talking about -- well, we are talking about professionals and perhaps Mr. Armson could address that concern.

THE CHAIRMAN: Well, I think he could indicate that the knowledge required to make the observations as a professional forester would be the

subject matter of professional forester academic courses or the normal realm within their experience.

But I don't think he can go much further to say what a particular professional forester looking at this would or would not think.

MR. FREIDIN: I don't think I was really wanting to go any further than you have suggested.

Q. And do you feel you could go as far as suggested by the Chairman?

A. I can certainly go that far, Mr. Chairman.

Q. Okay.

A. This was one of the soil pits that we used in our second year forest soil course.

Now, I apologize, this is rather a dark slide, but this is a view of the surface of a soil under a hard maple stand in an area south of the undertaking in Ontario, and it is taken in the early summer -- I should say mid-summer, sorry, and it is looking down on a soil in which the only litter are some twigs and some small pieces of foliage.

The litter I think is evident here in terms of these small pieces of twigs and the small pieces of the litter. It is not an uncommon -- it is quite a common type of situation in hardwood woodlots

in southern Ontario and in this situation the litter, which is of the same nature, annually arriving on the ground forms a carpet and by mid-summer it has been virtually, totally decomposed by the organism.

And, Mr. Martel, this is the situation where the nutrients, if you will, in the litter -- from the litter are being made readily available. This is an extremely fertile soil, very high quality, but it is an example of a situation where if you were to remove -- if you were to clearcut this kind of a forest, you would disrupt the cycle very dramatically.

There is no forest floor to speak of, there is no pool, it is all into cycling; and, secondly, the surface soil here, which is a mixture of both mineral and organic material, humus, would then be exposed to erosion. There is nothing -- there is no forest floor to protect it.

So here what we have is a situation of a very fertile soil, again, a species similar to what -- the same as we have in the Great Lakes/St. Lawrence region, but where an interruption, a disturbance which removes that forest can have some very dramatic effects in terms of both the nutrient cycling and the susceptibility or the opportunity for surface erosion to occur which, again, would be a question of reducing

the fertility of the soil.

Now, the situation you referred to in Brazil and many other subtropical areas isn't quite, but it is even further towards that situation. So the point I am making here is that within the area of the undertaking and in other parts of the province, the forest floor is a very important part of the soil and constitutes, if you will, a portion which provides buffering against certain kinds of disturbance.

The other factor that we have in our favour is also the climate, the rate processes are different.

MR. FREIDIN: Now, Mr. Chairman, what exhibit number did we give these?

THE CHAIRMAN: That would be Exhibit 418B.

---EXHIBIT NO. 418B: Photograph of area in Algonquin region depicting aspects of forest floor and fertility levels.

MR. FREIDIN: All right. So perhaps we could just -- I will try to yell out the exhibit that we are speaking to.

Q. And on 418B, Mr. Chairman -- I mean, Mr. Armson, does that picture depict an area within the area or outside the area of the undertaking?

A. This is a soil outside of the area of the undertaking in a woodlot north of Toronto.

Q. If you can just back up to 418A, just one photograph back, and you have referred to the organic layer as including humus. You may have pointed this out but, if you haven't, can we see that in Exhibit 418A?

A. In this soil there is virtually no humus, you cannot see it in the slide. There is a litter layer -- a layer of partial decomposition which we call a fermenting layer and beneath that there is a very, very minor layer of black organic material, but most of it is mixed in with the upper mineral soil and this is the layer I referred to as having a salt-and-pepper cover. So there isn't a humus layer of any substance.

Q. Okay, thank you.

MS. SEABORN: Excuse me, Mr. Chairman, just before we go any further, I am wondering maybe if we could have some copies made of the photographs, even if they are xeroxs, just so that we can have some paper that we can mark with these exhibit numbers when we are reading the transcript later.

MR. FREIDIN: Sure.

THE CHAIRMAN: Okay. Why don't we take a

break now and we can do that during the break. You can get that done during the break; can't you?

MR. FREIDIN: I think so. Sure.

THE CHAIRMAN: 20 minutes. Thank you.

---Recess taken at 9:45 a.m.

---Upon resuming at 10:15 a.m.

THE CHAIRMAN: Thank you. Be seated, please.

Mr. Freidin, before we rise today, we have just received the itinerary from Mr. Kennedy regarding the site visit next week and we have asked him to attend a bit later this morning so we can just review it quickly, I think he has got a couple of maps, and confirm the details with respect to this before we go because some of those who will be attending will have to start making flight arrangements and hotel arrangements and that sort of thing.

MR. FREIDIN: Okay. And just a housekeeping matter, Mr. Chairman,, I understand that a copy of the amended executive summary for Panel 9 and Panel 10 was made available to Mr. Mander. Perhaps we should give them exhibit numbers.

MRS. KOVEN: You mean the November 6th?

MR. FREIDIN: Oh sorry. Were they given exhibit numbers, I am sorry?

The panel statements were. Like panel statement for 9 was 414.

THE CHAIRMAN: Right.

MR. FREIDIN: And the executive summary is an amendment, it is a separate document and I was just going to suggest it be made 414A.

MRS. KOVEN: That's the December 29th...

MR. FREIDIN: Yes.

THE CHAIRMAN: That wasn't exhibited at the scoping session, was it?

MR. FREIDIN: I don't even remember.

THE CHAIRMAN: Okay. Why don't we do it on that basis, at least go back to the exhibit number to which the witness statement relates.

MR. FREIDIN: Right.

THE CHAIRMAN: So this one for Panel 9 dated December 29th, '88 will be 414A.

---EXHIBIT NO. 414A: Executive Summary for Panel 9 dated December 29, 1988.

MR. FREIDIN: Right. And if we do the same for the executive summary for 10 it will be 416C, I guess, because we have two volumes.

THE CHAIRMAN: Right. And that one is a redraft dated November 6th?

MR. FREIDIN: I think that's correct.

THE CHAIRMAN: Okay.

---EXHIBIT NO. 416C: Executive Summary for Panel 10, dated November 6, 1988.

THE CHAIRMAN: Mr. Freidin, I think in the future, so we do not get confused with the terminology, you are referring sometimes to these as the executive summary.

The title on them is: Witness Statement, Panel 9, redrafted, for instance, and we sometimes refer to them as statements of issue, and certainly what the other parties deal with are statements of issue with regard to the scoping session.

MR. FREIDIN: I am sure some people have other names for all of it, but...

THE CHAIRMAN: And that may well be so. So I think in the future let's try and either refer to the applicants as the executive summary which can be utilized as a statement of issue, or perhaps it might even make more sense to call it the statement of issues.

MR. FREIDIN: Well, I don't think really it is a statement of issues. I mean, it does outline basically the material which is in the book. My suggestion would be let's call the summary, if you will, the executive summary because that's a summary of

everything. Call the big books...

THE CHAIRMAN: The witness statements.

MR. FREIDIN: The witness statements.

THE CHAIRMAN: And what the other parties file will be statements of ssue. Is that acceptable to the parties?

MR. FREIDIN: On the scoping sessions.

THE CHAIRMAN: That's what we mean.

MR. FREIDIN: Okay.

THE CHAIRMAN: Yes.

MS. SEABORN: I am not sure, Mr. Chairman, we given our statements of issues exhibits numbers at this stage.

THE CHAIRMAN: No, we actually have not.

MR. FREIDIN: I don't think they should be, Mr. Chairman.

THE CHAIRMAN: No. But I mean your executive summary, since it covers and is supplemental to the witness statement could be given an exhibit number. But the statements of issue filed by the other parties will normally not be given exhibit numbers.

And you would only be getting -- Mrs. Koven points out, that you would only be getting a separate exhibit number for this if it is supplemental or separate from what you would normally file with your

witness statement.

MRS. KOVEN: If you revised it, otherwise.

MR. FREIDIN: Correct. We would have within the witness statement an executive summary. You just wouldn't have an exhibit number.

THE CHAIRMAN: Right.

MR. FREIDIN: And obviously the earlier ones...

THE CHAIRMAN: Does that clarify anything for everybody, or is everyone more confused?

MR. FREIDIN: Mr. Martel, you should be in charge of that, you like those things.

MR. MARTEL: Yes, definitions. MNR has some good ones.

MR. FREIDIN: We have one especially for you right in this package.

Now, Mr. Kennedy is here and I am just wondering whether we could just deal with that matter so that he can return to his other numerous...

THE CHAIRMAN: Okay. Why don't we deal with that, it won't take very long. Would somebody mind - unless Mr. Mander can hear us in our office - going down and getting him because I think we would like him here in case he has to make any arrangements

for the Board resulting from this discussion.

MR. FREIDIN: Mr. Chairman, I am going to have Mr. Kennedy run through this.

THE CHAIRMAN: Very well.

Mr. Mander, do you want to just be aware of what is being said here in case we have to make some arrangements through you.

MR. MANDER: Sure.

THE CHAIRMAN: Thank you.

MR. KENNEDY: Mr. Chairman, I believe we have made the adequate arrangements for the February 23rd site visit that is to take place in the vicinity of Timmins.

There are six participants so far that have indicated an interest in coming and have confirmed their attendance and they are shown on the first page of the itinerary which I just handed out. Those are representatives from OFIA/OLMA and Ministry of the Environment, in addition to the Board members.

There is a possibility of the media having a representative from the newspaper, I understand, in Timmins and Mr. Mander is going to be confirming that with them.

Our tour guide -- site visit guide for this particular visit is Terry Pawson who is an MNR

staff person out of the Timmins office.

We have included in the itinerary a list of travel times and stop times for each one of the stops as we have done in previous site visits. This is to be a rough indication of the time that we feel should be allotted each each stop and it is subject to change on the conditions when we get there and the interest that may be shown at the various stops. And we expect we should be back into Timmins at a decent hour. Our departure time in the morning from Timmins' hotels would be 8:15.

We have included a list of stop descriptions. I was wondering if you would prefer to run through that now or just be satisfied with having a careful read through it another time and refer to the map which we have posted in the hearing room.

THE CHAIRMAN: Well, we have read through this and it appears acceptable to the Board. I don't know whether any of other parties want to comment. If they don't, then you could perhaps just deal with the map.

MR. KENNEDY: Very wood. I would also like to point out that on the last page we have included a suggested list of things that may be helpful to bring along on a site visit, covering items such as

footwear, clothing and sunglasses which may be necessary if it is a clear, sunny day.

On this particular visit we are suggesting seeing some winter harvesting operations as well as winter site preparation operations.

The way we are going to do that is: Departing from Timmins, heading due south on to the Pine Street Road passing through Deloro Township and Adams Township with the first stop occurring in McArthur where there is a harvesting operation going on there.

THE CHAIRMAN: Could you speak up so the court reporter can hear, please.

MR. KENNEDY: And then we will be continuing in a southerly direction and we will be travelling through Bartlett Township into Bee,er Township and across into English where there are a variety of stops along the way.

In the course of doing that, we will be passing through both the Timmins Forest and the Mallette Forest and OFIA/OLMA reps from those two companies will be accompanying us to provide details if the tour guide is unable to do so.

At the end of the trip into Zavitz Township, there are three stops which are grouped

together. We have indicated them as separate stop numbers. Upon our arrival it may be that those will really run together as the operations are adjacent to each other.

At that point there will be a turn-around and returning on the same travel route up until the corner of McArthur Township and then there will be a side road taken that goes into Musgrove Township where there are some small operators working in that particular part of the forest.

And from that, turning around in there, it will be return trip into Timmins by a different route which will take us through the Townships of McArthur, Adams and into Price Township and then into Ogden Township and back to Highway 101, at which point we will go for a short visit through the Mallette Waferboard Corporation mill where there is a particle board and a waferboard and a thin board production line, and provide the Board with an opportunity to see a modern mill utilizing those products.

THE CHAIRMAN: Thank you.

MR. KENNEDY: Mr. Chairman, I will leave some extra copies of the proposed itinerary at the back of the room and parties are welcome to have a look at the map. And I will also be faxing a copy of this

itinerary to those people that are out of town that will be participating on the visit, and will put the itinerary in the mail to the full-time parties.

THE CHAIRMAN: Is it going to get to any of the full-time parties before the visit takes place?

MR. KENNEDY: I don't believe it would in that case, no. We faxed the proposal last week and those that we have heard back from, I would suggest we would fax a reply to them. Otherwise I was going to put them in the regular mail.

THE CHAIRMAN: Okay. I think it would be sufficient if you fax a reply to anybody who responded to the original notice of the visit.

MR. KENNEDY: Very good. We will do so.

THE CHAIRMAN: And those who didn't on the rest of the party list, I think if you just put in the mail. Obviously, they didn't want to respond for whatever reason in the first place, so that they will get it in due course.

And the Board, of course, after the visit will put something on the record as well, and you will instruct your guide to prepare a sheet after the visit as well so that we can exhibit that.

MR. KENNEDY: Very good.

THE CHAIRMAN: Thank you.

MS. SEABORN: Mr. Chairman, just while we are on the topic of site visits, you may recall when site visits first arose, the question, last spring, we had suggested that we would like at some point the Board to have an opportunity to go back to the same area again in a different season.

And with respect to the Timmins visit, we would just like the Board to keep in mind whether or not a visit to the same area could be scheduled when we have our satellite hearing in the Timmins area, and it is something that we will raise when we get closer to the time. And I just wanted to raise it now so that the Board would be advised.

THE CHAIRMAN: Very well. We will certainly bear that in mind, Ms. Seaborn.

Anything else with respect to the site visit? Very well.

Mr. Freidin?

MR. FREIDIN: Okay.

Q. Mr. Armson, if we could continue with these slides.

A. I wonder if we could have the lights.

Mr. Chairman, I would now like to deal with -- in terms of the slides, deal with the matter

that Mr. Freidin initially mentioned and that is the question of thickness or thinness of soils and the perception or understanding of soils.

MR. FREIDIN: And I understand we are now looking at 418C -- this is slide 418C. It is an exposure of soil and materials in the area of the undertaking.

---EXHIBIT NO. 418C: Hard copy of photograph of area of the undertaking depicting exposure of soil and materials.

THE CHAIRMAN: Excuse me, I think some of the parties are having difficulty hearing over your machine. Would you mind using the mike. You might check your machine. It sounds like it is going to blow up or something.

MR. ARMSON: Check the machine.

MR. FREIDIN: That is it, hit it again. That is better.

MR. ARMSON: I will use the microphone, though, and keep my hands free for the pointer too.

This slide depicts both a soil and materials often referred to as soil by some persons in the area of the undertaking. This is a soil in an area -- in the northern region in one of the Crown management unit forests, the Plonski Forest to be exact, and it is an area that was being cleared in this

instance for the development of aforest nursery and that is why in the picture the portion of the tree that you see up here (indicating) is dead. The stand has been harvested in part and some of the residual trees and stumps are left.

What I would like to draw the Board's attention to are the most obvious features shown in the picture which are, first of all, that there is an upper zone in the picture which is highly coloured and exhibits different colours.

The surface which essentially is the forest floor as we have come to recognize, and then beneath that an area of much lighter coloured materials, almost white; beneath that a zone which is reddish brown, and beneath that a material that extends right to the bottom of the picture which is very light coloured.

So the perceptions that you have there are primarily of colours and also of the existence of -- with the large tree on the left, or the remnants of the tree and the root system which has been somewhat cut off and I would point out that the long root here hanging down was in fact a lateral root which extended out to where the soil has been removed. Now, those are the colours.

To anyone looking at this, you would say that was a thick material. The rod which is here in the picture is the black, and the white or silver colours are in decimetres, so that we have approximately over two metres depth here. And the reason the rod is put in there is because close to the rod there is a root which is in fact going down into this body of very light coloured material.

So that the roots of the jack pine that you see, although predominantly in this upper zone characterized by the horizontal white and light and the reddish brown colours, there are some -- a few roots, one in particular, that is in fact extending more deeply into this material.

The material, I have to say, is a sand, medium sand. It is a material that was deposited by water and is a rather extensive deposit. The upper part characterized by the forest floor, the very light coloured area and the reddish brown, in the parlance, if you will, of soil science -- if we were describing the soil here, this zone from the forest floor to the lower limit of the reddish brown coloured material, would be the soil.

The soil is in fact, if we look at the scale to the left, something of the order of 30 to 40

centimetres thick, yet the material which we are looking at, both at the soil here and the material beneath it, is extremely deep. In fact, I understand from some geological borings it may be a hundred or more feet deep.

So that when we look at that, I think to most people they would say it is a deep soil, but in fact the soil in the narrow sense -- the zone that in soil science we call the soil and the zone in which the bulk of the roots are situated is, in fact, a relatively thin part of that total material.

So that when we talk about thinness or thickness, we have to define what -- whether we are speaking of soil in the soil science sense, and that is particularly appropriate when we are looking at where root systems are and/or where we were talking about the materials in which the soil - and now we come to a piece of jargon - when we look at a soil in cross-section and we look at these horizontal or horizons, we call that a profile.

I think in Panel 2 we looked at an example of that with some jack pine root systems too. The point here I want to make is that the forest floor is again in tact, there is a thin soil profile which is rooted by, in this case, the jack pine that had

occurred there, but that the materials beneath it, being sandy and deep, are extremely porous, so that all the attributes that we have described with respect to a complete forest floor cover, but now also in terms of water movement, hydrologically the movement of water through this material, through the soil profile and down through the materials, the geological materials underneath the sandy materials is relatively -- is unimpeded and, in fact, we can say that then deduces if there is water - and this would occur particularly in the spring - which will flow through the soil because it is saturated and more water is added, then it will flow down through here and eventually move towards the groundwater and the stemflow from that.

There is some significance in the rooting of the jack pine, not only in terms of the major root systems being associated with the soil profile - and I will come to that in a moment - but also because of this vertical root. You may recall yesterday I talked about water moving along the outside of root systems and the stemflow and then moved along.

And, in fact, if there is considerable stemflow it will move downwards and, of course, the roots that are vertical and going down, they tend to lead the water down and we often find in soils with

soil development very great irregularities beneath what we normally think of the soil profile, and these are usually related to the occurrence of deep-rooting species, and jack pine usually has some of those roots, and it has a considerable significance in terms of moving water rapidly to lower levels.

THE CHAIRMAN: Mr. Armson, without giving us a whole course in it, what is the reason why certain roots go down and certain roots go laterally? Does it have to do with the species of the tree, or is it seeking out water or what? Why do some roots go down and some roots just go laterally?

MR. ARMSON: And you wanted me to answer without getting -- well, very simply, sir...

THE CHAIRMAN: Ten words or less.

MR. ARMSON: Very simply, sir, the first root out of a seedling is normally one which is susceptible to the influence of gravity, it goes down. But as far as we know, and we are not clear, the roots of trees will -- after that initial root, will grow in any direction in which they originally -- originate from a given point and they will grow in that direction unless they are stopped by a physical impedence or where, as they grow, there are moisture or other conditions; temperature, which tend to influence the

direction in which they move.

Roots will grow sideways, vertical, both down and up, obliquely, they will grow in circles, they -- I have seen roots that have grown in the form of a pretzel, believe it or not.

So we really don't know. Essentially I think we have come to the conclusion with tree roots that they mostly grow in the direction in which they are headed until they are influenced by external forces. There are physiological controls, but I won't go into that.

THE CHAIRMAN: Thank you.

MR. FREIDIN: Q. Now, Mr. Armson, do certain species have particular rooting characteristics, however?

A. Yes, and I will be showing an example of differences between two species later on.

Q. Okay.

A. The rooting, the bulk of the rooting within what I will call the soil profile now is a reflection of, first of all, the nutrients that are contained within both the organic matter and also within that upper portion of the weathered material.

I referred to the weathering of the soil particles or of the particles in the geological

material and the reddish brown material in here reflects in fact accumulation, particularly of iron compounds and they have resulted from the more intense weathering here in the zone just above this very lighter coloured area.

And chemically we know that that, and in fact if you look at it physically you will see that it is predominantly silica grain and these are the residuals from the weathering of the geological material at the surface. And I referred to temperature and moisture.

This is the zone which has the -- in terms of weathering and biological processes, this is where the temperature is highest, it is also the zone which receives the moisture. So the soil profile then is really a very active area and this is reflected in the actual development of that profile over time.

Q. Mr. Armson, you referred to the biological activity being an indication of weathering?

A. Yes.

Q. And what are the things -- would you see an indication of biological activity other than the colour of the soil? Would anything else indicate that there had been biological activity?

A. Well, you see the roots, that is the

most obvious thing. You would also see in the forest floor layer - you can't see it in the slide because it is taken from far back - you would see evidence of the activity of micro-organisms and decomposing organisms in that area.

I think in terms of the movement of water, I have referred to that in this soil, it is essentially unimpeded. The thin profile and, again, the forest floor area, I don't think I have to emphasize that, becomes an important part and this is also on a relatively flat topography, so that in terms of timber management, this would be a soil in which we would say you could carry out a wide spectrum of activities in terms of both harvesting, in terms of site preparation, and subsequent tending without negative impact as long as there was a maintenance of the forest floor to some degree.

It doesn't even have to be a total forest floor remaining there from the initial stand. This is -- in other words, this is an area where prescribed burning not only could be used but has been used as part of the site preparation.

Q. And one last question: You referred to the soil profile, you said it could be described as a thin soil?

A. Yes.

Q. Could you also describe it as a shallow soil?

A. It is shallow in the sense that it has a limited depth.

Q. All right. Shallow in the soil scientist's point of view?

A. Only in the soil scientist.

Q. Thank you.

A. This would be to the average - to the lay person I think it would be deep, in fact many people would call this soil -- this is really an unweathered geological deposit, waterlaid sand.

---EXHIBIT NO. 418D: Hard copy of photograph depicting soil profile.

MR. FREIDIN: Q. Now, explain Exhibit 418D?

A. This is a soil profile and the upper part of the geological material in which it is weathered in the same Crown forest, in the Plonski Forest, and what is most evident in this picture in contrast is, first of all, there are stones and small boulders in the picture showing quite evident (indicating), they are angular to sub-rounded we would say; in other words, they are not totally angular but

they have some rounding.

They occur both in the soil profile which again is evidenced by the forest floor, the total forest floor isn't depicted in any great clarity there, and underneath that a light coloured zone as in the previous soil and the reddish brown, perhaps the most obvious feature of this, is that the reddish brown zone is more diffuse. It would be hard to draw a line underneath it and, in fact, beneath it it diffuses into lightish yellow colours and almost what one might call a small amount of mottling, that is a little dark colour. And this has some significance in terms of, first of all, both the material - and I will explain that - and then come back to what the influence would be.

First of all, the fact that it is -- Oh, I am sorry, and towards the base the material is lightish gray in colour with some small amount of yellow perhaps, but there is evidence - and I would assure you this is not just from the way it was dug - of sort of horizontal lines, and I don't know whether that is particularly clear, but you can see it even up in here, almost little shelves of material as it was cut away.

Geologically this material is called a

till, if you recall yesterday, what some of the studies that were conducted in terms of nutrient withdrawal were in soils which were called tills. These are materials that are laid down either as the ice sheet advanced and, therefore, are heterogeneous, they are a mixture of all kinds of particle sizes, they contain rocks and boulders. The boulders and rocks are usually somewhat angular, may have some rounding, and they are laid on as the ice advanced and, therefore, are compacted.

This is one of those types of tills which was smeared on as the ice advanced and has, therefore, these lenses or lines of compaction. This has some considerable effect in terms of water movement.

MR. MARTEL: Is that proceeding or advancing or just...?

MR. ARMSON: Advancing.

MR. MARTEL: Just advancing?

MR. ARMSON: Yes. The other kind of till that we often find in much of the area is when the ice retreats and the materials are dumped out, largely associated with water, so the rocks and boulders with it tend to be more rounded and the materials are looser and usually coarser and they are usually towards the surface.

So that it is not uncommon to have a basal till laid down when the ice advanced and, we call it an ablasion till or a dump till when the ice retreats, and you get this vertical stratification between these two tills.

THE CHAIRMAN: Was this the Pleistocene period?

MR. ARMSON: This is the Pleistocene period, yes.

---EXHIBIT NO. 418E: Hard copy photograph of soil profile depicting Pleistocene period.

MR. ARMSON: Now, in terms of the forest floor, it is very similar in thickness to the proceeding one but, as you will see, the rooting depth in here - and this next slide will show it - but because of the compact nature of the material, the movement -- the downward movement of water on this soil material is restricted and it is restricted by this compact till nature.

So that the rooting that is possible in this is quite different, the area -- zone available for rooting is quite different from that which was available in the sand.

However, because of the nature of a till which is a mixture of materials that have not been laid

down by water, the geological component here, the upper part of which has been weathered to perform -- is normally considered more fertile, richer in nutrients or at least has the -- if it is weathered it will be richer in nutrients.

So in the range of fertility, till soils, the foresters are -- or I and, I believe most foresters, know an area as tills versus waterlaid materials, particularly sands, then they would automatically have a sense of higher fertility on the tills than on the sands. I think that is a very general observation virtually all foresters would make.

I would like to show you the root system of a jack pine of a similar age on this till.

Again, the roots that you see largely in the front of the slide are hanging down and the photograph is somewhat different coloured, but it gives you a much better appreciation of the location of the major root system of the jack pine. You can see the roots in here which are in the upper part of the profile and the till and the upper portion of the till where it begins to merge into the soil profile is about in here (indicating) and you will notice there are no roots growing down.

And characteristically - and these are

jack pine roots of the same age, the stand is of the same age, as in the previous one about 70 years - so that in this till, which has the opportunity for higher fertility, but it also has a physical restriction of root -- the depth to which the roots can go, and it also has a physical barrier to rapid movement of water through it.

So that in terms of water movement, these soils are quite different in terms of fertility, there is a difference, yet they are both supporting the same species.

MR. FREIDIN: Q. Could you advise what defines the depth of soil in that photograph?

A. The depth of soil here is essentially -- as I say, of the soil profile, is the same as in the first slide on the sand. About -- this is of the order of 40, maybe 50 centimetres at the most. So the depth of soil as we define it in the narrow sense is about the same, but there is a limitation to the manner in which roots, particularly of jack pine, can go below that.

Q. Right. And in that regard, is the rooting configuration of that particular jack pine a common one?

A. Yes. This is taken some distance out

from the stump, but this was part of a very major study on the root system of jack pine in these range of soils. So this is -- I can assure the Board that this is a common and typical form.

Q. What is below the soil, what is the material?

A. The material below it is the relatively unweathered till beneath.

Q. And is that a compacted till?

A. That is a compacted till.

Q. If it wasn't compacted till but was the dump till, would the roots of that jack pine have a different configuration than as shown in that picture?

A. We would expect the roots of the jack pine to move and exploit the dump till which is usually a loosely and uncompacted material.

MR. MARTEL: How much water would it take to affect an area like that, or could it, based on the fact that that was a compacted area? Would it take a real -- let's say to do some ponding or something like that.

MR. ARMSON: Oh, these soils -- these soils do not erode. I should say, although there is a compact layer, they do not normally erode.

The water holding capacity of even the

soil profile is high, there is a forest floor and in fact there is not -- we do not have ponding. What we do have - and I referred to mottles, slight discolourations bluey gray, and what that indicates is that within this zone, which is really below the main rooting zone, there are periods and locations of saturation, but it is not complete and so we have the mottles.

And that is one of the visual signs to a soil scientist looking at a soil, as soon as they see mottles, it may be quite dry when they look at it, but they say that -- they immediately know that sometimes seasonally that soil has saturation or partial saturation. Does that...

MR. MARTEL: Yes, thank you.

MR. ARMSON: Right.

I would like to go to the next illustration. This - and I am sorry but the lights in here may not - I think the essential features will show.

MR. FREIDIN: Q. I am sorry, the last photograph that we were looking at was 418D.

A. Yes.

Q. And now you have gone to 418E. In relation -- and just one question before we go on to

that -- you can leave it there.

Mottling, is that something that a professional forester would know, or would you have to be a soil scientist?

A. I think most foresters would remember something about mottling and in the various documents such as the Forest Eco-System Classification, that is described and indicated and that is for the use of foresters. I think they would be well aware of the term, and what the implications were of that in the soil.

Q. Thank you. We are moving on to 418E.

A. 418E is a slide taken in --

MRS. KOVEN: I think this is F; isn't it?

MR. FREIDIN: Pardon me?

MR. MARTEL: F, I believe.

MR. FREIDIN: I am sorry. 418F, I am sorry.

---EXHIBIT NO. 418F: Hard copy of photograph of soil in the area of the undertaking in Clay Belt.

MR. ARMSON: 418F then, Mr. Chairman, is a slide of a soil within the area of the undertaking in the northern region and in the area of what is commonly called the Clay Belt. And this is a large area which geologically was, at one time after the retreat of the

ice, a large shallow lakebed.

And in the slide the most obvious feature perhaps is that towards the bottom where you see horizontal layers of whitish material and brownish material. And these are the sediments that were laid down in that lake and the whitish material consists primarily of silt-sized particles and the thinner brownish layers of clay particles.

And the sequence of them represents essentially the annual cycle of water coming in with coarser particles, spring melt water and then during the late summer when there is less you get the finer particles settling out. So that we have almost what might be viewed as a chronology with the older sediments here (indicating), the older sediments towards the top.

The soil which is developed - and you will notice that the top of the scale, the tape that is in here, and I aplogize, it is a tape and I can't read the figures very well, but just about the bottom of the slide is one metre.

This is 90 centimetres right -- just above the top of the slide and the surface of the soil is just at the very top of the slide, so approximately a metre in depth.

So that the profile of the soil, which is very bland, it just looks brownish here, there is no whitish layer -- the profile is something of this -- this is the lower boundary, again somewhat irregular but of the order of 40 to 50 centimetres in depth.

This was a soil underneath a forest stand, in this case, a 68-year-old black spruce stand, close to the -- actually to the Little Abitibi River, and in this particular stand you will notice that the root systems are quite superficial. They are within the forest floor zone which is right at the top of the slide and some extending, but minimally, down into the soil.

So here not only do we have a thin soil profile, but the species -- the black spruce which is occupying it, occupies a very limited portion of that soil. In terms of water movement, the soil itself, because of the fine texture, has a very high water holding capacity but a very limited ability for water to move through.

I think, Mr. Chairman, yesterday you asked about clays and clays being -- I think in the example used, as a coating, an impervious - although this is not a clay it is a clay loam because of the silt - it acts in much that same fashion.

The water movement is quite limited so that in this zone, this type of soil, if there is a very high intensity of precipitation then this is one -- and a low topography, this is where you would expect to have some seasonal movement of water or holding of water towards the surface.

In this particular instance that doesn't occur because the topography is somewhat gently rolling, but this is the kind of situation -- if it were flat, one might expect that to happen.

These soils are very fertile soils in terms of the northern forest, primarily because of the clay components in the soil itself.

Q. So could one come to any conclusion about the fertility by observing merely what is in this photograph?

A. In the photograph one couldn't come to that conclusion. That's a conclusion I am coming to because I happen to have taken the picture and been there.

This is, however, an example - in contrasting it with the previous two soils; that is, the till and the sand, and particularly the sand - this is an example of a soil where, in terms of spring operations and activities with equipment, this is where

you might run into great difficulty with your equipment, rutting and so on could occur at that time and these would also be soils that would, as we say, dry out more slowly than those of the sands or the tills.

So there is a physical aspect to the three soils we have seen; the sand, the deep sandy material, the till with a relatively thin profile but which had a very compact layer, and this one which had a fair clay component.

Q. And any observations which would provide information about erodibility?

A. The erodibility here then, if there is a removal again of the forest floor, there would be a high potential for erosion of the surface layers because of the nature of the texture and also because of the moisture-holding properties of this finer textured soil.

So here is where, in terms of judgments and decision-making that might be -- decisions would be made with respect to this in a different way than it would be with the till or with the sand.

THE CHAIRMAN: I take it, Mr. Armson, that in the areas where you have superficial root systems, those areas would be more susceptible to

blowdown as well; would they not, or would they?

MR. ARMSON: Yes. In general terms, yes.

MR. FREIDIN: And I think there will be some slides later here which speak to wind firmness.

MR. ARMSON: I would like now to move to another area of the undertaking, going to the Great Lakes/St. Lawrence region and, in particular, looking at the root systems and soils, in this case, of hard maple and this is in a mature stand of hard maple, these are relatively large trees.

---EXHIBIT NO. 418G: Hard copy of photograph of area of undertaking in area of Great Lakes/St. Lawrence Forest depicting rooting of mature stand of hard maple over bedrock.

MR. ARMSON: I think in the photograph it may not be too evident, but the base of the bole of this tree is shown at the very top. There is a section through the soil very close to the base of the maple tree and what you see here are the roots of that one tree, and I think that the slide -- most obvious feature of this slide is that the tremendous intensity of rooting from this maple tree.

We have seen in the first slide the root system of a jack pine. In the slide just before this, we saw the lateral superficial roots in a 68-year-old black spruce stand.

This is a maple system and you can see that it is very intense and occupies a very, very well defined zone within the soil. There are some lateral roots, they do extend, but the bulk of the root system is very close underneath the crown of the stem.

MR. MARTEL: Are there certain maples that run along the surface -- certain types of maple where the roots in fact run along the surface as opposed to going down?

MR. ARMSON: Yes, red maple. Red maple is a species that is characterized by -- well, first of all, Mr. Chairman, this may be of interest - but in terms of deciduous commercial tree species it extends from Florida to the Arctic height of land and watershed. It is one of the most -- in terms of latitude, it is probably unique in that sense and it, has a root system which is very, very superficial and really can move anywhere. It occurs in swamps and it occurs on very, very thin soil, on bedrock. It is species you can grow virtually anywhere.

The soil in which this maple is growing is again a boulder till, a compact till. The picture doesn't show the lower part of the soil profile, it is down beneath the slide, but the rooting of that profile, the profile is not overly deep. You will see

that we are dealing with, in this case, approximately 60 to 70 centimetres in depth and, in fact, the profile is something of that order, but the rooting primarily is within that zone.

It is, in other words, again a deep material in terms of the boulder till, but both the profile and the root systems are restricted to the upper part of the material and well within the less than a metre in depth.

---EXHIBIT NO. 418H: Hard copy of photograph depicting shallow soil over till.

MR. ARMSON: You can see in the slide the characteristic weathering of the upper mineral soil surface, that lightish gray area and the litter above that. The forest floor -- in other words, here is very similar to the one that I showed you on the very first slide which was of the maple litter with the six-inch ruler and the partially decomposed material.

So we have, again, a deep material, shallow soil and again a physical -- because this is a basal till, a till which is compact, as I say doesn't show in the slide, we have a limitation to water movement moving vertically through that.

What I would like to do now is move in the same area to maple, the same species growing on, in

this case, Mr. Martel, a dump till. This is where there is no basal till, it is a dump till, as the ice receded it dumped the materials down and it put it over bedrock. This is a granite and ice bedrock.

You can get some sense of the size of the trees. It is a very typical type of hardwood stand actually in the Algonquin region, and you can see that the root systems -- in fact there is more than one, but of this particular tree is very similar in nature to that which we showed in the previous slide on the till, the basal till.

But this -- I think if I were to show -- to look at it, the first thing I would say it is shallow because I can see the bedrock. Yet in terms of depth of the rooted soil and, indeed, in terms of the depth of the soil itself, we are dealing with a situation which is just as deep, perhaps in some instances even a little deeper as in that pocket that is shown there.

---EXHIBIT NO. 418I: Hard copy photograph of bedrock configuration with jack pine rooting system.

MR. ARMSON: Now, this has considerable implications in terms of both the growth of the forest and also of the manner in which water will flow through the system and be available both in terms of joining

the groundwater and also in terms of water availability to the trees.

If we think about it in terms of what happens to water when it moves into each of these two soils, in the first instance, in the boulder till, it will move down through into the soil, partly be absorbed by the root system and some of it will move slowly into the till, depending on the moisture content, but it will move relatively slowly and it will then move out of the system. There will be very little lateral flow here. There will be some, especially in the spring when the materials have a considerable water content.

In this one the water will move in, will again move through the soil, but then will be ponded or pocketed. In fact, there is a small ponding of water in there and sit in depressions within the bedrock or flow through any of the fissures or cracks in the bedrock and then move out, either to join the groundwater system or go to deeper layers within the rock.

Q. There will be lateral movement?

A. There would be some lateral movement and that, again, would be affected by the configuration of the bedrock. So the configuration of the bedrock

now takes on a rather important aspect of the movement of water both within the soil and certainly then along the surface of the rock, in this case, as compared with the basal till in the previous slide.

Both soils are productive in terms of moisture supply to the trees and, in fact, we might expect some degree of higher water supply here within this soil because the bedrock is holding it up, but not as a water table so much, as in pockets, which is not too bad a situation, you have always got some roots sticking in the water somewhere if it is there.

So we would -- these two soils, although they appear different are essentially, in terms of the growth of the tree, in terms of the moisture relation, very similar. In terms of the forest floor, they are almost identical. So we could equate them although they are different types of materials. As I say, this would -- to some people say it is a shallow soil over bedrock with certain implications that they might put to that.

This is Mr. Martel's favorite slide. I believe, Mr. Martel, this is the one that you asked some questions about in Panel 2 last year. So I have returned to it because I wanted to show you the difference in rooting on this kind of a soil.

This is again a deep material, but in this instance the waterlaid material was finer and is compact and the root system of the jack pine - this is approximately 60 years old - is extensive, certainly in terms of lateral roots, you can see that. Certainly a very clear indication of the difference between this kind of a root system and one of hard maple, but at the lower extremity there is a compact material and the roots tend to stop there, they are physically prevented from penetrating at deeper levels.

I will be showing to the Board the nature of the stand, the forest stand in which this particular tree is situated, this jack pine, because it is of interest in that it has not only a jack pine major -- it is a major jack pine stand, but it also has black spruce of not quite the same age, a few years younger, but in the same material and in this slide which is...

Q. 418J, I believe. It is J.

---EXHIBIT NO. 418J: Hard copy photograph of bedrock configuration with black spruce rooting system.

MR. ARMSON: We have the root system of a black spruce that is a few years younger, not very much, which has become established in the same soil material and which shows very, very clearly the difference in rooting within that soil by these two

species.

MR. FREIDIN: Q. The roots we see sort of hanging down, are they hanging or is that the original direction?

A. This is a hanging root (indicating) and this is a hanging root. (indicating) The root system -- the body of the root system is up in this area as contrasted with the previous one which has a much more dense root system of vertical depth.

MR. MARTEL: Isn't it jack pine that are supposed to have the shallow rooting?

MR. ARMSON: No, jack pine has a relatively deep rooting system. Red and white pine have even deeper rooting systems, but jack pine is -- if you were relating them to shallow, medium and deep, jack pine would be on the medium to deep side, given the opportunity to grow in the soil.

MR. FREIDIN: Q. Mr. Armson, by those two photographs, 418I and 418J, we had similar soils but two different species which exploited the soil differently?

A. That's correct.

Q. Does the difference in terms of how a particular species might exploit or use -- the degree to which it would use the total soil depth have any

significance for silvicultural decision-making?

A. Yes. In general, we would look at a soil and in terms of the species, certainly in this case with jack pine, we would say that the jack pine is better able to exploit, to utilize that soil and, in fact, is more productive in terms of growth as a result of that. Whereas black spruce would utilize only a limited part of the soil that is available, the upper zone and, consequently, would not be as productive on this site in terms of volume.

Q. I would like to refer you to a line or two on page 38 of Exhibit 414 and, in particular, the last paragraph on page 38 which speaks about -- I think the situation is perhaps depicted in these two photographs:

> "...is inherently a species which is shallow rooting will not be able to exploit deep soils and inherently deep rooting species will be restricted in their rooting capability by shallow soils."

And has that been shown on the slides?

A. Yes. This is what I am referring to here, yes.

Q. It then says:

"This does not mean that such species do not grow or should not be grown on these types of soil, but that the implications concerning species demand for water and nutrients compared to the soil's capability to meet these demands should be recognized and understood."

Is there a rule that the optimum combinations of species -- there should be an optimum combination of species and soils so that the species takes full advantage of whatever soil is there?

A. Normally in management. If your management objectives are such that you can utilize the species that is best suited to exploit or utilize the available soil volume, that is what you would move towards and that is what we, in general terminology, would call matching the species to the site.

There may be situations where - and as I indicated in the evidence - where, because of some other factor such as the value of a species, that one might move towards a species that does not necessarily utilize the entire rooting volume but, because of its value, even if it does grow more slowly, you would move to that.

But that is where I am stating in the

evidence you would then have to recognize that in terms of water -- availability of water to this shallow rooted species, it isn't going to be able to utilize the water in the lower part of the soil profile to the degree that jack pine, in this case, would.

So those are the kinds of things you would recognize if you move towards species that did not do that.

MRS. KOVEN: In a situation like that, Mr. Armson, would have a denser stand?

MR. ARMSON: Sometimes, yes. In the natural stands that is usually the case, it seems almost a reverse. But often on the poorer sites, as we say, either through -- more particularly through fertility, we often have a denser -- a higher density, many smaller trees.

Normally what happens on the more fertile sites is, because of the rapid growth, there is a sorting out by the population with the ones that have some dominance, growing faster and, in fact, both competing and shading out or -- not only shading out, but taking up the moisture and nutrients that are available.

So there is a tendency to have higher densities, yes, on the poorer sites.

MR. FREIDIN: Just one moment.

Q. Thank you. Just going back, on those two slides, could we tell anything from the slide in terms of erodibility?

A. In erodibility, perhaps it is more readily seen in this one. These soils -- this again is a sand, it is a finer sand, as I indicated it is in a very level topography, it has a forest floor that is uniform there, as you can see and, in this instance, this would not be an erodible soil in the normal sense with maintenance of the forest floor to some degree.

Again, it is an area in which -- in terms of harvesting, in terms of site preparation and subsequent tending treatments, this would be a soil over which you could employ a wide spectrum of practices and also in terms of the conditions, the physical condition of the soil, these would be most difficult soils, for example, to compact them with equipment or machinery.

Q. Can we just back up to the slides 418G and H, that's the shallow soil over bedrock?

A. Yes.

Q. And the one before it?

A. The one over -- the maple over till.

Q. Shallow soil over till?

A. This is a shallow soil over till.

Q. If someone was concerned about erosion, would there be any different considerations in the two situations that are depicted by those photographs, one being shallow soil over bedrock, one being shallow soil over till?

A. The shallow soil over till, which you see here, the materials, because it a basal till, the materials tend to be a finer texture.

If you were to remove all the forest floor layer and expose the mineral soil, then it would be more erodible, to put it that way, than this one which is a -- because it is a dump till has a coarser texture and more difficult to erode.

Q. And if you don't remove the forest floor, is there any difference in terms of the concern about erodibility?

A. No.

Q. Thank you. The next picture is 418K.

---EXHIBIT NO. 418K: Hard copy photograph of stump of 80-year-old white pine in bedrock.

MR. ARMSON: Yes. In this picture, Mr. Chairman, I am showing you the stump of an approximately 80-year-old white pine in a stand of white pine in a situation characterized, as shown in

the picture, by bedrock. Some part of it is covered only by moss material, which you can see to the top left-hand side of the photograph, but the bedrock itself is fractured.

The size of the particular tree here, but also the fact that there is essentially a full stand of white pine, this a stand that is actually visible from Highway 35 in the Algonquin region and sits on a butt or rock outcrop over the lake, adjacent to a lake and, as I say, highly visible.

It illustrates the fact that productive -- in this case, pine can grow and in fact this was an area that was harvested by a silvicultural harvesting system on soils which are extremely shallow no matter how we define them.

And superficially, if you don't look at where the roots are, you wonder how in fact a tree can in fact become that size. And the answer lies in the fact that there is no soil profile in the conventional sense, there is no unconsolidated material, in effect, in which that tree can grow except perhaps in the odd pocket. And I think what you have in here is a small depression in which possibly when the ice retreated and the water scoured the surface there was some residual material put down in there and over many centuries, if

not a thousand years, there has been succession of vegetation.

Pine, as I indicated, has a system - white pine and red pine - that the roots can go long distances and they can go in virtually any direction you care to point them.

The root system of this tree, and indeed of the roots of the entire stand, have penetrated every -- virtually every crevice and crack within that fractured bedrock and over the generations of trees that have occurred here, and the reason that the pine is here is largely these were areas under normal circumstances burnt quite regularly, every 80, 90 or 100 years.

So although this very shallow soil, almost no soil at all, we would think of it as being very susceptible and sensitive. This has been subject to some fairly major disturbances on a regular, although infrequent manner.

The root systems of each successional generation occupy the fractures and fissures - and I will show you an example of that - and what we have in those fissures and cracks is really an accumulation of dead root material, organic material which slowly decomposes, releases nutrients and, in fact, the

soils -- the fertility, the supply of nutrients to these trees is really, from the organic material, largely put in there by the succeeding previous generations of vegetation, particularly of pine.

If there were a statement, this is where the heirs are living on what their ancestors have left them, quite literally.

It also superficially would seem to be a condition of extremely low availability for plant growth and, indeed it is. If you take the surface bear rock, what is happening here is that all the precipitation that comes down is being channelled either by the trees itself by stemflow and crownflow down into the root system, and if it is out here on the rock, apart from the mosses which may be absorbing some, the water is being channelled right down to where the roots are.

It is probably one of the most efficient systems for the utilization of water by vegetation and it is that, together with the fertility which arises from the residual decomposing organic material, that gives the productivity that it has. I am not suggesting that it is highly productive, but it is a moderately productive stand and condition.

THE CHAIRMAN: Mr. Armson, I don't know

whether you do it because of the topography, but you wouldn't want then to utilize a full-tree harvest method there; would you, because you would be taking out some of the roots and therefore...

MR. ARMSON: In this particular stand, which as I say was harvested and I was partly but not entirely responsible for the prescription, it was harvested on a tree-length and it was -- because it was white pine, a shelterwood system was used, so that in other words, the entire stand wasn't cut and, in fact, in the conditions for the contractor he was told to, where possible, when they were felling a tree, to fell it so that the crowns, if possible, would come down on any open rock which was around.

Of course, that is what he wanted to do anyway because it was an opening and wouldn't get hung up.

So what the point I am making here is that although these are extremely shallow soils over bedrock in terms of what you can observe from the surface, they can indeed be productive and with appropriate harvesting or other activities they can in fact retain that productivity.

MR. FREIDIN: Q. Mr. Armson, you indicated that fertility was -- one of the reasons for

fertility was the predecessors of a stand that was there?

A. Yes.

Q. And could you explain what you meant by that?

A. What I mean by that is, when this tree dies as it has already, we've decapitated it, these root systems also die and will slowly decompose and the nutrients within both the wood and, more particularly within the bark, will then become available.

Some of that will move through the system as water moves through those crevices and fissures but much of it will remain, and that which remains, in terms of the organic substrait, will be available to a subsequent generation.

Q. All right. Would there be any nutrients added to those areas, these are like the fissures over the life of the stand?

A. Yes, there will be some. If you look in some of these fissures and cracks you will find chemical weathering of the bedrock. There is some addition that way.

There is also - and perhaps to a greater degree - there is some nutrients being added by the

moss vegetation which is growing and dying on the surface of the rock itself. So there are minimal additions. I wouldn't want to suggest that they are large. From one -- one may ask: Where does the -- where do the mosses get their nutrition. Partly they get it from some very superficial weathering of the rock, but a large part of the nutrients the mosses obtain are from the crown, the washing of nutrients from the crown of the forest trees. This has been studied particularly in places like Sweden.

Q. Now, you have also got -- these are the areas which you have described as extremely shallow over bedrock. What does the picture tell us about erodibility?

A. The erodibility is virtually nil, there is nothing to erod. There are some mosses that could dry out here and that is a possibility and they could be, as they dry out they may blow. But they are -- in these kinds of situations, they are intermittent but that certainly could erode, but in terms of eroding rock, I am afraid that is just not in the picture.

One has to consider the ice has been over this and retreated over it and we have still got the rock left.

Q. And where you have indicated here that this tree is in a -- I think you referred to it as a pocket.

A. I am surmising that the seedling that became established and became this tree, that by the configuration there was probably a small pocket of soil in there and that is where it became established. And that is often the observations on these shallow areas with bedrock, that the vegetation becomes in these pockets or crannies and crevices and so on.

I believe the next slide shows you...

Q. Which is 418L.

---EXHIBIT NO. 418L: Hard copy photograph depicting fracturing of rock.

MR. ARMSON: This is again, and I show this to illustrate an area where, if you like, the fracturing of the rock is not so evident. There is some fissure in the rock, it is a horizontal one. It may not be too clear, but there is a white pine log up to the right, the stump of the pine is at the top right-hand side of the picture and here you have a very -- a rounded bedrock which had a very, very thin mantle of essentially organic material, some litter, mosses and in the odd spot some mineral soil. But essentially an extremely -- you could walk over it and

put your heel down and you would hit the rock.

And the point of this is to show that in these, where there is not the deep fissures, there is still a very considerable exploitation of whatever soil is there. Where you see these roots going out in this direction (indicating) there was a heavier covering of organic material. There was very little in here, but even there you see these small roots, and where there was a fracture through this bedrock which, as I say, was horizontal one, on the right-hand side of the picture you can see a medium-sized root moving through and coming out the other side of that fissure.

So it is a variation on this, but it illustrates an area in which, again, a relatively large individual - I am not suggesting these are again the most productive stands, there is some degree of opening, but they are still stands that we would call productive in terms of timber management and the water supply is a very immediate one, the nutrient supply is dependent entirely on essentially an organic substrait with some very minor addition from the weathering of the rock which is quite minimum. These are granite niches, they are not the most rich in terms of nutrients.

MR. FREIDIN: Q. Do you have any

information as to the quality of the trees on those sites?

A. These trees would be intermediate. The trees in these areas were saw logs, these were white pine saw logs.

Q. And do you recall -- do you have any information as to the site class under the Forest Resource Inventory for those sites?

A. I can't recall exactly, no. I would -- from memory, I would think they would be a low Site Class 1 -- 2 rather and maybe an upper 3, but they would be in that zone.

Q. Okay.

A. Certainly Site Class 3 and maybe even a little bit better.

Q. Thank you.

A. See, this was to illustrate basically -- I was able to trace one down into a fissure, a deep fissure - and I aplogize, you can't see everything - but it is like looking at a cave here. But to give you -- this fissure was filled entirely with organic material and what I am illustrating here - and I think it can be seen in the bottom half of the slide - is the intensity of rooting, even a large root at the bottom of that fissure. These were pine roots

and they were actually part of the root system of the tree that you saw in the previous slide.

So it's very, very difficult in a way to estimate, if one were to say: What is the volume of soil exploited by these roots, there is no way you can really arrive at the totality.

You were talking, Mr. Martel, about wind firmness. These are about the most wind firm trees you could ever get, they are anchored in the rock in this fashion.

MR. FREIDIN: Q. Mr. Armson, on these extremely shallow soils over bedrock, can you comment on the renewability of those types of sites after harvest?

A. Well, as I indicated in the earlier slides with white pine a shelterwood silvicultural system can be used with some discretion concerning the nature of the logging system; shortwood or tree-length system would be quite appropriate.

The time of year in terms of harvesting is not really very critical because there is not much you can do with equipment, in fact, it is more a question of what the site would do to the equipment than the reverse I think, in this case.

With jack pine, will also occur. There

are a number of species that will occur in these types of conditions and they can be treated silviculturally and harvested and the productivity maintained.

The season of year may be important in some instances if natural regeneration is being used, particularly for jack pine.

Q. Okay.

A. I am going to leave roots now and show you, I believe it is two slides that -- of an area in northwestern Ontario in the Dryden District and I am not sure, it may well be an area that the Board saw or flew over last summer.

---EXHIBIT NO. 418M: Hard copy photograph of area in Dryden District depicting exposed bedrock surfaces.

---EXHIBIT NO. 418N: Hard copy photograph of area of Dryden District depicting shallow soil over bedrock.

MR. ARMSON: This is an area that was harvested commercially and which was then seeded approximately ten years before the picture was taken. The picture was taken last summer.

The area is very generally characterized by exposed bedrock surfaces which you can see in the slide, there is no question about that. The area had been harvested and the species that was taken was jack pine.

It was productive, in that sense an economically viable operation and it was deemed an area that should be regenerated and it was, in fact, regenerated as I said by -- or if I didn't say, it was regenerated by aerial seeding. You will notice that the bedrock surface is identified by the light colour in the slide. There is a considerable amount of it, in fact, those bedrock surfaces existed prior to harvest; in other words, the commercial forest that was taken off what's occurring -- the trees were occurring in the same kind of pockets that the regeneration which is now approximately ten years old is growing in. In this particular situation the regeneration was very successful and led in fact to a very high density of stems. And although it is not perhaps clearly visible in the slide, this area was tended by a pre-commericial thinning operation done by the Ministry in order to remove the excessive numbers of stems that were there.

Now, I would like to talk about this in terms of water and productivity. The water availability in this area, as I mentioned with respect to the white pine, any water that flows onto rock moves into the, depending on the configuration, down into those small pockets which is where, in this case, the vegetation, particularly the trees are growing.

If we had left this or if -- this is an area that was originated as a natural -- from a natural fire but the natural stand there, we seeded it. If we were to leave the high density of stems in those pockets and they would be depending on the soil moisture supply and the nutrients that were there, then the decision was that if they were left, we would have a large number of small trees and they would be competing for the same amount of water and nutrients.

If in maintaining the productivity of this forest, this new forest, we wanted to in fact change the dimensions of the forest to our satisfaction, one of the simplest things to do is, again like carrots in the garden, is to thin it out and this becomes particularly appropriate when you have a limited amount of water flowing into those pockets on these shallow soils. So that the pre-commercial thinning operation was done to in fact provide for the moisture and the nutrients to go to a smaller number of stems which would form the next forest.

This is an example of where the decision was made, not because of any set of unique studies or data, but an understanding in general terms of the relationships between soil, soil water supply in this case and the density of the stems.

I believe the Board will recall last summer in Panel 4 that there was some mention of the area that Mr. Cary was responsible for as a unit forester and this is a view of Mr. Cary in one of those areas, again shallow soil over bedrock, and again the lighting conditions aren't perfect but I think you can see the height of the jack pine. This is an area that was cut-over and was regenerated and, in fact, was one of the areas referred to by Mr. Cary when he was unit forester...

MR. MARTEL: That was his wild young days?

MR. ARMSON: That's correct, Mr. Martel. Again, this is merely a ground photograph of something similar and I thought the Board might...

THE CHAIRMAN: So what do we entitle it, John Cary in forest?

MR. ARMSON: I would suggest that it is unit forester revisits the site of his earlier predictions...

And that, Mr. Chairman, is the end of the slide show.

MR. FREIDIN: Q. And, Mr. Armson, I am going to -- I would just like to ask you a few questions arising out of those photographs before we

move onto the next area.

THE CHAIRMAN: Mr. Freidin, we are contemplating going through until about one. Do you think you will finish?

MR. FREIDIN: No I mean, no, I will definitely not finish. So, if you were contemplating a break it is not going to affect whether we finish or not.

THE CHAIRMAN: Do you need a break?

THE REPORTER: No.

THE CHAIRMAN: You might as well just push on to one and I think we will quit at one.

MR. FREIDIN: Okay.

Q. Are there some situations with the characteristics or that could be described as shallow soils over bedrock where you would not harvest, Mr. Armson?

A. Yes.

Q. And perhaps you could expand on that?

A. Well, that would be where there are -- there is no soil at all and essentially no forest. I mean, that is the situation in which you wouldn't harvest. If there is a commercial stand of timber, then I think you would look very closely at how you would harvest that.

MS. SWENARCHUK: Could you turn it off now.

MR. FREIDIN: Turn it off. Are you going to let that go?

MR. ARMSON: No, I think it has cooled down now.

MS. SEABORN: Mr. Freidin, could Mr. Armson just repeat that answer, I wasn't able to hear properly.

MR. ARMSON: The answer, Ms. Seaborn, was that where there is a shallow -- where there is a soil and there is a productive stand on it, I would see no reason not to proceed, but obviously there are factors that would influence the decision of how and when to do that.

MR. FREIDIN: Q. Can you expand on the kinds of those factors, the sort of factors that you would have to consider?

A. The factors would be related particularly to, for example, the consideration of nutrients in terms of the pools of nutrients that would be either removed in general terms or would remain and in terms of the moisture supply and the susceptibility of the particular situation to, for example, erosion. I think that would be one of the key features that we

would look at.

Q. Thank you. Now, given the variation in the site conditions that you have described in your oral evidence and which you have shown some of in those slides, how do foresters know the situation that they are facing in terms of the soil?

A. Well, they know it from existing information about the soils, where that is, available and, as I say, that is available in a number of the areas to some considerable degree now.

Q. When you say that, what kind of information are you referring to?

A. They would be soil surveys in the form of maps. There could be surficial geological maps which provide a great deal of information about the materials, though not about the soil in the narrow sense itself.

There would be information that would be contained in reports or such as the Forest Eco-System Report, that would not provide a map per se, but which would characterize in describing the normally occurring vegetation and soil conditions and related moisture characteristics for a broad area.

Q. And when -- is that reference to the Forest Eco-System Classification that we have heard

about?

A. That's correct, yes.

Q. Okay.

A. And which I believe has been an exhibit. So in addition to those reports and so on, there would then be the information that the forester would have locally from both people who operate there, whether it be the industry or some others, from his own staff and his own observations and in this he would be utilizing -- he or she would be utilizing such things as aerial photographs.

Any of these areas in the photography will show up in terms of exposure -- bedrock exposure and so on. He will also be utilizing the local knowledge in general of the relationships and what has happened because many of these -- I think you will see from my slides, they in fact have illustrated what can or cannot happen when you carry out a certain activity in a given situation.

So there is a whole array of pieces of information and knowledge that will be at his disposal to a greater or lesser degree depending on the situation.

Q. Okay. And in the absence of the soil surveys that you referred to and in the absence of the

Forest Eco-System Classification, could you comment on the sufficiency of the information available to field foresters to make sound silvicultural decisions?

A. It would be my opinion that even without those other aids, if you will, that the knowledge and, particularly the ability to see either from photographs or from their own actual visitation on areas and from the observations of trained staff, that this is a good basis for making the silvicultural decisions. I won't say that it is the most complete, but it certainly is, in most instances, a good basis for it.

Q. All right. And why, if you have a good basis for making decisions in those situations without the soil surveys and Forest Eco-System Classification, why has the Ministry involved itself in developing Forest Eco-System Classifications and doing soil surveys?

A. For two reasons: One is that is to better improve the decision-making; and, secondly, in terms of surveys, it allows the forester then for a given area to have a quantification of the nature of the various soils that have been -- that are there and this, of course, was one of the key purposes for the undertaking in the northern region of compiling all the

available soils information for that region.

So that all foresters, be they industry foresters or Ministry foresters, would have that information at their disposal.

Q. In material that I have read - and I would think the material that others have read about this matter of timber management - we sometimes see the term fragile site, sometimes the phrase sensitive sites. Could you comment on those two terms?

A. Yes, and I believe in my witness statement in Panel 9 I placed the word fragile in inverted commas. The words fragile and sensitive really have no meaning unless they are further qualified in terms of fragile with respect to what or sensitive with respect to what.

And, therefore, to identify a site or a soil condition as fragile or sensitive and leave it at that really tells, in my opinion, nothing about the site itself or what decision should be made with respect to it being labeled just fragile or sensitive.

Q. Could you give an example of how one might sort of go off in error by not considering these characteristics?

A. The best example I can give is the example that was illustrated in one of the slides of

the white pine stand which was, as I say, a stand overlooking a lake adjacent to a public provincial highway.

It was originally by foresters - and I am speaking now of university staff foresters in this case - considered as a result of other peoples' opinion as a stand in this condition which should not be touched at all and yet it had quite a mature and commercially valuable stand of white pine.

Q. Why do they believe that it shouldn't be touched?

A. They believed it shouldn't be touched because - I wouldn't want, the years have gone - they used the word sensitive, but the implication was it was sensitive or fragile because of the nature of the rock, that it was exposed and anything done there would have a detrimental effect.

When we looked more closely at it it became clear that in fact this was not a sensitive site at all, it was a site that, if dealt with properly, could maintain a pine forest in perpetuity if it was managed in a certain way. So in fact the site was not sensitive, it was in fact a site that was rather resilient in terms of the way it could be treated.

Q. Thank you. The next area that I

would like to move on to is the area ---

MS. SEABORN: Mr. Chairman, I don't like to interrupt Mr. Freidin, and I wanted to wait until we finished this area. One of the things that has concerned me a little bit in this direct examination is the amount of new material that has been introduced without any notice to the parties in the form of these photographs and there has been considerable discussion about those.

Now, I accept that the photographs do relate to the material that has been provided in the Panel 9 witness statement, but it does somewhat, I would say, broaden the evidence that is now going to be in front of the parties in terms of cross-examination.

And what I would ask is that for future panels that Mr. Freidin be required to give us some notice if there is going to be some new material that is going to be relied on in-chief so that we can have that in advance of the panel.

MR. FREIDIN: All right.

THE CHAIRMAN: It would probably be more helpful, Mr. Freidin, particularly since the parties may want to submit interrogatories on it as well.

MR. FREIDIN: I hadn't thought of that and I will follow the suggestion. I hadn't thought

about the interrogatory process.

I was thinking that if I made those photographs available without a lot of oral explanation as to what they were really all about, they would be perhaps confusing and not very useful. But I will try to meld my professionalism and Ministry direction in my future activities.

MS. SEABORN: Thank you.

THE CHAIRMAN: Whatever that means.

MR. FREIDIN: Come on, you know what it means.

Q. Forest as a production system, Mr. Armson, that is dealt with on pages 18 to 25 of the witness statement. And does this particular section of the witness statement have any relationship to the evidence that you have given regarding productivity of forest sites?

A. Yes, it does, because the production - and, as I indicated yesterday at the beginning of this discussion - that the growth, the productivity is essentially a function of, as I said, air, water and nutrients.

And in terms of the nutrients in the water, we have dealt rather exhaustively I think with many of those aspects. So this is why the productivity

and the production is dealt with in the evidence statement.

Q. What is the significance of the biological fact regarding increased demand for nutrient and water as the stand ages? That is a comment I believe that's in your witness statement.

A. Yes. When a forest stand is established, the demand, if you will, for both water and nutrients is relatively small in absolute terms although the rate that may be required may be quite high. Young material has a relatively high rate of growth, therefore, the rate is high but the seedlings or the small vegetation has not a great absolute demand.

Further, the root systems which are being established are on an annual basis extending out. If you visualize -- and in fact if I might, Mr. Chairman, there is a figure on page 20 which shows the stages of development and I might perhaps refer to that, if I may.

It is a very fundamental point and it has a great implication in terms of decisions that are made regarding a forest stand at different stages of development, and I have alluded to one or two of them.

But if you visualize the soil as being

the medium from which the tree or the seedlings are going to obtain the nutrients and the water, then the volume, as characterized here in a schematic way, is a fixed volume. If there is no more soil, what you see is what you get.

The seedlings, the small vegetation growing is growing physiologically at a high rate but it has a small dimension, so the amounts in total -- and the root systems are expanding. So, in fact, what they are doing is continually moving out to new sources of both water and nutrients. The water can of course move to the roots too.

As that stand develops, the crown -- which as we have mentioned before as indicated, the crown which is the large repository for nutrients within which -- is expanding in size. So when we talk about increasing demand, this is really what we are talking about. And the root systems at this point are beginning to define, if you will, the exploitable soil volume as you saw in the previous slide.

As that goes on and we have what we call crown closure, the slide doesn't show it exactly, but where those crowns now meet, we would say in our terminology the site is fully occupied. We are talking about what we see above ground. But perhaps even more

importantly than what we see above ground is what is going on below ground because when the soil volume is totally occupied, there is no further availability in terms of exploitation by new roots of that soil for nutrients and water, and characteristically what we find is that the rates of growth of stands that are in this juvenile bole -- we call it a bolewood condition because in our forest there are often trees that are maybe a few centimetres in diameter, 10 or 15 feet in height, maybe a little taller - that is often a stage at which we recognize that there is going to be competition for the limited supply of water and nutrients.

I will just refer back to the last two slides I showed you, the last one in particular, that pre-commercial thinning in the jack pine which was done at age 10 was done, in my opinion, and biologically at precisely the right time because that is when the onset of root competition particularly would occur below the crown -- would be height.

So we recognize that a decision in terms of reducing the competition within the forest that we are managing, if we were going to reduce that competition we have several time periods in which we will do it. Obviously when we are established with our

trees and there is other competing vegetation, so that would be the early stages. But more particularly the management of an established stand, we are looking at it in this more juvenile polewood condition.

Q. Go ahead, Mr. Armson, I can hear you.

A. As the stand increases in size, there has been some mortality naturally or we may have thinned it, more usually it is natural mortality, and we find that it becomes mature and what we mean by mature -- I believe Dr. Osborn went through a number of explanations of maturity, biological maturity, economic maturity and so on. I won't go into that, but I am here referring to biological maturity, whether that coincides with the economic one is not relevant.

When that stand is mature it reaches a point, in effect, where the individual tree has got its demand and the supply of moisture and nutrients and, more particularly, moisture in our part of the world is in fact not a fixed one but it is a variable, about a mean, and if you have then a sequence of seasons, particularly when you get lower than normal moisture, then those organisms, those trees which are large and have large absolute demands, then they are susceptible and prone to what we call stress. And as soon as that occurs we get some biological loss from the organism

and the loss comes in two ways.

The root system is not a static thing; it is continually redoing itself. The large roots are there but there are continually new fine roots being put out and lost. They are the key absorbing organisms. If a stand of trees reach this point where there is stress, where there isn't enough moisture at a time in their seasonal development, during the growing period when they require it, then physiologically they will not be able to operate in the normal fashion. We talk about drought.

What happens then is that there is a breakdown in terms of the production system in the crown, photosynthetic ability, and as a result there is less than the adequate supply of food materials manufactured which would go to building new crowns and also new roots, replacing roots.

So that what we often get is not an immediate effect but we get over a period of two or three, four seasons a reduction in the absorbing root system, a less than normal development of new foliage. And so we have, in a sense, a factory in which the supply system is now faltering, is being reused, and the manufacturing plant in relation to that is not operating at full capacity and, therefore, we have a

biological organism that when anything -- if the stress continues or some other stress comes into play, we will then have a breakdown and what we run into then is an over-mature and the organism itself, as we say, dies, it shows the symptons of death. And this is illustrated in this last...

In the meantime, of course, everything has left, there is other vegetation which is coming up. As the root system of one organism dies, new plants will come in and occupy the soil.

MR. MARTEL: Are trees susceptible to disease, the roots at this stage?

MR. ARMSON: Yes, very susceptible, very susceptible when they -- they may be infected by certain diseases when they are alive and healthy, but they become extremely susceptible to root diseases when you get more than normal root mortality.

We have diseases which normally operate on dead organic material, but when there is a lot of dead organic and sort of working on it, then the next thing you know they have the ability to attack live roots.

So this whole process of demand is one that is constantly going on and in any stand can be related to that stage of development. And part of the

decision-making in silviculture is based on having an understanding of that development in the general sense and being able to then, with that knowledge, make use of it in terms of management objectives and what is possible in terms of the economic management of the area.

MR. FREIDIN: Q. As the stand ages, does its susceptibility to insects and fire change?

A. To fire generally, yes, but to insects -- insects is a much more dynamic situation. Young stands can be attacked by insects. I wouldn't suggest that insects -- they can bring about stress by removing foliage and so on, and certainly insects which infect the root collar and we have in young plantations various insects which can bring about mortality in the stands.

Q. When you have this -- if naturally you have this stage of development, are the species which occupy the site after the other -- the existing stand gets matured, over-matured and as it dies, do you get the same species when this occurs?

A. You could, but often you don't get the same species. You get other species that are adapted, well adapted to moving in and occupying the -- and this is really part of what we term succession, one

species or groups of species will often succeed another. We have examples of that later on.

I perhaps might point out to the Board, although it isn't in the evidence, that where you have a situation of very low supply of moisture, low supply of nutrients you can in fact have perhaps the longest live individual trees. If you think of the areas and the situations in which we talk about very old trees, they tend to be on some of these very, very severe in terms of supply -- limited supply, water and nutrients.

The best analogy I can give you is a bonsai tree which is a tree that is relatively small, it can be very old when it is grown, and the art quite literally of growing bonsais is to grow them in very, very minimal amounts of moisture and nutrition.

MR. MARTEL: Would the density be low in those areas then of the number of trees?

MR. ARMSON: Well, as I mentioned to Ms. Koven earlier, where there is low fertility often that is where you get high density in the natural stands.

But where you get to these very, very extreme situations in terms of moisture supply, no, usually it is very sporadic occurrence to the individuals. You don't find stands of them in the same way that we do...

MR. FREIDIN: Q. Mr. Armson, in the area of the undertaking, are you able to point to, by way of example, any stands, commercial stands which are long living but are nonetheless in a low fertility area?

A. The stands, particularly of pine, both jack pine and white and red pine, the longest living individuals would tend to be -- and retain their health, if you want to put it that way, would be on these very severe low moisture supply situations.

Q. Thank you. Now, you mentioned succession--

A. Yes.

Q. --in answer to a question from me. Does this reversion or knowledge of natural succession have any significance for timber management?

A. Yes, it does. It is a very important part of the understanding of foresters in relation to their decision-making, silvicultural decision-making, with the knowledge of succession, the natural succession that can occur and also a knowledge of the influence of the natural factors of disturbance, how that either interferes with or may change the nature of succession.

This is a very important area for foresters, particularly where they are making

silvicultural decisions concerning harvesting and the type or nature of treatment or not having that treatment.

Q. Could you provide an example of that?

A. Yes, I can. I have within the Panel 9 statement an example from the the Temagami area, and I have an overhead of that.

Q. Page 60?

A. Page 60, and also I believe page 62 - these are data from a study, and this is Figure 16 on page 60 - these are data from a study that was undertaken under my supervision a few years ago in Temagami of a number of stands.

This is just merely one stand. It was a 160-year-old white pine stand. It had not been harvested or, to our knowledge, most people should know there had been no timber mangement activity. So in that sense it was, I suppose we would say, a natural stand.

There were a number of them, but this one in particular illustrated some of the elements of succession. The stand itself had become established after a natural fire some 160 years ago. If you look at the columns of data on the left-hand side of the figure you will see that there is both a measure of

stocking, as we referred to yesterday in terms of square metres per hectare, and also of density in terms of the number of stems per hectare.

What shows up very readily in the figure is that for white pine -- the white pine is by far the largest component in terms of stocking and if you visualize the stand -- in other words, the large trees are white pine, and there are 150 of these to the hectare. Two other coniferous species are there and that is balsam fir and spruce and they are then quite minor stocking, but in total numbers they are in excess of the white pine.

For the hardwood species or deciduous species, again, the stocking as measured by basal area is low compared to the pine, about one third in total, and for the individual species, maple, white birch and poplar, the maple is by far the predominant. So in terms of the stand itself, it is a white pine forest but within it it has other coniferous and deciduous species.

The study looked at the regeneration, that is the smaller growth that existed on the area and, in this case, the stocking was measured in the way that we would regeneration. I believe that Mr. Gordon in Panel 4 gave an explanation of stocking quadrant

which has either got a tree in it or it doesn't have it, and then the species would be identified.

Q. So these two columns then, would that also be properly described as being the understorey?

A. Yes. Some of these trees may be in physically the understorey, but the next slide will show that.

Q. Okay.

A. But these are certainly all in the understorey, the regeneration. And from that you will see that - the slide is perhaps a little wide - but in terms of the both the stocking and in terms of the density, the species that predominates is maple with 71 per cent stocking and stems per hectare 56,000 stems per hectare.

I would just suggest to the Board that in the orders of magnitude with which we have been discussing density, you will recall that 2,000 stems in an over-mature black spruce stand was considered very dense. Here we have an even younger stand, we are talking about tens of thousands of individuals. I will show you the vertical dimensions of those.

So in terms of both numbers and stocking, by far in a way we are looking at a pine stand within -- and other species and they are predominating,

particularly in terms of regeneration. There is pine there (indicating) and there is pine there (indicating) in some considerable numbers but the stocking is very low. That tells us that there are pockets of pine, a large amount of pine in pockets and this was in fact the opening.

The next figure is for the same stand and the same species in which we are looking at the vertical dimension of those species. And in the slide to the left-hand side you have at the bottom left a summation of all the heights for all the species. And what stands out there is that there is a low frequency or number in terms of stands per hectare of the larger height classes.

In other words, those are the four histograms to the extreme right of that lower graph. Then there is the break in actual fact, and then you have a series of histograms, something which you can visualize is something like a frequency curve in which the predominant heights are somewhere between eight and ten metres in height. So this will give you some idea of the physical dimensions.

If you look at the maple you will see that in fact the largest component in there, as we indicated from the slide, is maple. When you look to

the right-hand series of histograms where the other species are shown -- and in this you will notice that white pine -- we have put white pine down at the bottom not for any particular reason, but you will notice that the white pine has a series of height frequencies and the smallest amount, as we saw from the original data, was in the larger sizes and there are, in fact, three -- you might say three separate boxes of them and that tells us something.

And this, again, is the kind of thing that one with knowledge of this -- that there were in fact two periods. If this is the oldest stand, the tallest, then there were two periods within the lifetime of that stand when there were opportunities for regeneration and growth of white pine.

We don't know what they were exactly, but from an examination of the area it wasn't burnt, it would be that there had been some windthrow in there and openings created and there was a seed source of white pine. I merely use that to give you an example of how, looking at certain kinds of data, one can make some deductions, granted they then would have to be verified.

The height frequency for the other species, balsam fir, a very, very high frequency in

terms of individuals in the 8-12, 15 height class. In terms of the spruce, not as high a frequency but a more variable set of height; in other words, there are some small ones and larger ones. In terms of the white birch, very definite clumping there and, in poplar, virtually none at all.

So what we have is a picture of a stand in which the overstorey and canopy is white pine, it is not dense and beneath that there is a very dense understorey comprising some white pine but more particularly a very large amount of maple and of balsam fir in particular.

So in terms of succession, with no further disturbance, we would deduce that as the white pine, mature white pine becomes overmature and dies, as it will inevitably, the stand will be occupied to an even greater degree and the existing understorey predominantly of maple and balsam fir would then become the predominant species both in terms of numbers but also in terms of the upper canopy.

That has implications if we want to, in fact maintain, white pine in this particular area. One of the first things we would have to consider is how do we in fact control the competing vegetation that is already there and well established, and that is going

to be difficult because of the size of it, then that makes then a whole series of options. This is the way in which that particular example of succession will be viewed.

I have another example--

Q. Yes.

A. --if I can proceed with that, which is illustrated in the evidence by...

Q. Figures 14 and 15 at page 46 and 47.

A. No, Figures 14 and 15 --

Q. I am sorry, you are right

A. On page 58 and 59.

Q. Sorry.

A. And I would ask the Board to think back to one of the slides that I showed, the coloured slides.

Again, this was the picture of the jack pine root system that Mr. Martel was interested in and the black spruce root system that we had in the same stand, actually just a few feet away, and this is a figure illustrating the numbers per unit area, in this case, numbers per hectare.

So this is exactly the same stand and what we are looking at here is the distribution of the population, if you will, of jack pine, which is the

predominant species and black spruce. The stand originated after a fire approximately -- the fire wasn't approximate, it was 57 years before the measurements were taken, so the stand was about 55, 56 years of age.

The vertical axis indicates the density of the numbers per hectare, the horizontal axis is the age. The first thing that strikes you is that we would speak of this in forestry terms as an even-aged stand, jack pine -- in fact in the inventory parlance it would be considered a jack pine stand, jack pine 10 -- 100 per cent occupancy.

But you will notice that even in the jack pine there is some variation in age but the predominant age is that class that came in after the fire, natural fire. You will notice there are a little -- in terms of the jack pine, there are some younger age-classes.

There are some jack pine as young as 42 years of age, or as old as that if you want to put it that way. These are, if you like, small areas where the jack pine has regenerated naturally, but you will notice that the other smaller amounts of species in there, the black spruce is distributed right throughout that and we have spruce in there as young as 12 or 15 years of age.

What has happened here is that fire went through it was essentially a jack pine stand, it was a well-drained soil as you saw, it regenerated naturally because of the nature of the species, the conditions for natural regeneration of spruce were not conducive because it is a shallow-rooting system, it is sandy and it could not get its root systems out to utilize that moisture. So we have a scattered understorey, spruce and a predominant understorey of jack pine from the same fire.

The same fire went through an area just a short distance away, two or three kilometres south in which the soil was finer textured and, as a result of that, and topography it was not well drained, there was moisture being held in the upper levels of the soil. The stand that burnt was exactly the same stand that was on the preceding one, it was a jack pine with some spruce and undoubtedly this part of it may have a little more spruce on it, but what we see here, again, it is a main age stand, the predominant species is still jack pine, but within that stand there is in fact a clustering of age-classes some of which are the same age and these are black spruce. And if you move into that stand, look at that stand, you actually are looking at stems of black spruce as well as jack pine.

So that if we are to harvest this stand - and some of that black spruce is equally harvestable, it isn't small - and if it is small or younger this material up here has some similar -- we have a silvicultural choice.

If our management objective says we would like to enlarge the spruce, in this case the black spruce component of our productive forest system, then this is where we would consider doing it. We would not, under normal circumstances, consider doing it there.

Q. There referring to Figure 14?

A. On 14. So that a knowledge of not only the succession but why that succession has been altered and, in this case, we can relate it to the difference in moisture conditions in the two soils, could influence the kinds of judgments we would make.

If we wanted in fact to grow jack pine on a soil with a better water supply capability, this is where we are going to do it. But we would also recognize that because of that the root systems will be more shallow, you don't have to go deep, so that in terms of wind firmness I could postulate that jack pine on this soil would be less wind firm than jack pine on that soil.

Q. Would be less wind firm on Figure 15?

A. On Figure 15 than on Figure 14.

Q. Okay. Now, those two Figures 14 and 15, were the situation in the boreal forest?

A. These were stands, I believe both of them - one of them has been harvested - these are stands that were, again, in the area of the undertaking in the boreal forest and, again, on a Crown management unit in the boreal region.

Q. The Figures 16 and 17 in relation to the white pine stands, which forest region are they in?

A. They were in the Great Lakes/St. Lawrence forest region in the -- actually in the Temagami District of the northeastern region.

Q. And in relation to that white pine stand, could you perhaps expand or indicate how one might use the information about that white pine stand to make silvicultural decisions about whether to introduce timber management to that stand and the type of activity that you might introduce into that stand?

A. The most obvious feature of the stand is that in order to maintain white pine, in order to regenerate it to white pine, there would have to be some very considerable form of site preparation that would remove the existing well-established, quite large

species of maple and balsam fir. So that would be a major and probably considerably costly undertaking to do that, certainly if it was to be done in any mechanical way.

Q. Now, Mr. Armson, you have spoken generally of the implications of the demand for nutrients and water plasy in making silvicultural decisions.

I am just wondering if you could provide the Board with any examples of how the demand for nutrients and water has that had implications for silvicultural practices? Even if you have to use a hypothetical, that is fine.

A. Well, I think some of the examples I have already given in terms of the pre-commercial thinning of the jack pine in the Dryden District was one where the decision was to in fact allow the much lower density stand of individuals to take advantage of the supply of moisture and nutrients in that situation. I believe that would be a good one.

Another example would be - that I haven't referred to particularly - would be one where, in the establishment of a new stand on a soil situation which was fertile, rich in nutrients and the full knowledge that competing vegetation, and I am thinking here

particularly of herbacious but more particularly low shrubby vegetation would be very prolific such as with hazel and mountain maple, that there would be a recognition that in establishing, let's say, spruce or some other species there, you would have to very particularly control the competing vegetation in the initial stages of establishment in order to allow your stand that you -- the individuals that you put in there to grow rapidly and exploit the soil itself.

I think that would be a very immediate one that many foresters have to deal with.

Q. Could the amount of water supply have any effect on the harvest technique or tending practices that you would want to engage in?

A. Yes, to a degree. Obviously the water supply in terms of harvesting - I think I have addressed that in terms of the cutting of trees in terms of water table level and whether it would or would not influence that level. In terms of the application of a tending technique to minimize or reduce competition from unwanted species, that normally would have virtually no effect on the moisture relation -- in terms of water table, it would certainly -- what you are doing is providing for the immediately available water to go rather to the roots

of your stand -- your artificially regenerated trees rather than to the hazel or the maple that is side by side with it.

Q. Mr. Armson, will you turn to page 22 of the witness statement for Panel 9, the bottom paragraph reads that:

> "Local differences in soils, slope and aspect can alter temperature, moisture and nutrient cycles and thus influence the rates of primary production and metabolic loss. This means that foresters must take into account these factors of site, climate and their effects on tree species if the silvicultural practices chosen are going to be most effective."

Can you supply some examples of how these factors of soil - and maybe you have provided those already - but soil, slope and aspect can have these sorts of influences on temperature and moisture and nutrient cycles?

A. Okay. Since we haven't discussed temperature to any great degree perhaps I will start with that.

The degree of slope particularly on a

south or south-facing aspect can have considerable implications. The greater the slope in the northern hemisphere, then the greater the amount of radiation it will receive from the sun. So that I think most people who -- height will know this, that in the early summer or spring day if you want to go to a warm place and the sun is shining, you go to the south slope; you don't go to the north slope.

And the steeper the slope, then the greater the heat that that receives, energy that it receives and these are, therefore, the areas that will dry out more rapidly. So that in terms of the vegetation that is established there, it can be more subject to the stresses, the seasonal stresses than if it were in a flat or particularly on a slope which had a northerly aspect.

Slope and aspect are two features that you have to really consider in combination. So that there -- in terms of a species that is considered to be sensitive to moisture stress, slope, particularly a south-facing slope would be one that you would probably avoid if you could.

The second feature related to species differences other than just moisture stress. White spruce is a common species in the area of the

undertaking, it is also a very valuable species, it is a species which we know, because of its habit of -- and generally starting its height growth earlier than black spruce is susceptible to late spring frost.

In other words, if we have a frost occurring in June and we have black spruce and white spruce growing side by side particularly in the early stages, and by that I mean in the first decade or so of growth when they are relatively close to the ground, then we can almost guarantee that if we have a late spring frost the white spruce will be damaged with the new shoots emerging maybe three, four centimetres in length, they are very susceptible to low temperature injury.

The black spruce, because it starts its growth later, just physiologically it doesn't -- buds don't burst as early, is normally but little affected if at all. Obviously very late spring frost and early summer frost can also affect black spruce.

Now, if we put white spruce on a slope, particularly a south-facing slope, we are doing all the things to encourage the spruce to think that spring has come even earlier because it is warmer. It will warm up earlier, the buds will break and we will have an even greater susceptibility to frost damage.

So that if we were choosing where we were going to place white spruce, slope and aspect could well be a consideration and we have many, many examples in the boreal forest of where spruce has been placed either in a situation - not necessarily on a slope - but on a flat area susceptible to late spring frost.

So that is one area in which slope would be a factor. I think we have dealt considerably with soils and the moisture and nutrient cycles.

THE CHAIRMAN: Conversely would it not grow better if you planted it on a south slope and there was not a late frost; grow faster, put it that way?

MR. ARMSON: Yes, but it also has a moisture factor in terms of just temperature and the radiation that is received, yes. But in terms of the early stages of development, one of the ways in which attempts have been made to minimize that is by leaving some form of a residual stand to break it up, to give it some shelter; in other words keep it cooler so that it doesn't extend its growth as early. But there is variability depending on where it is.

MR. FREIDIN: Q. All right. You have spoken about the relationships of soil and now you have spoken about slope and aspect and their relationship to

temperature and nutrient cycle system.

Are all of these relationships that you have been speaking about over the last day or so, are they such that they can be the subject of rules telling foresters what to do in given situations?

A. No.

Q. Why not?

A. The knowledge of the relationships that I have been describing in the last day and a half are the subject, to a very large degree, of the professional education of a forester.

The key feature I think in the employment the key factor -- in the employment of that knowledge to whatever degree is that it can only be employed really in relation to the specific situation, the forest conditions in which that forester is going to make decisions concerning its management.

It also relates, and I think I emphasized this, to the management objectives that are there and placed before the forester and which he has a responsibility for undertaking.

MR. MARTEL: But would it be part -- I think you have been talking about, for the past couple of days, part of the formal education that they in fact take. They might have to apply it locally and become

familiar with the area they are in, but the background knowledge is part of the formal education though; isn't it?

MR. ARMSON: That's correct, in fact it is one of the larger segments of what we would say constitutes the basis of education and training of a professional forester.

I would give you a couple of examples that I actually have referred to. A knowledge of the amount of snow that can be held by the crowns of different species is very -- is useful too. I don't say the foresters think about it all the time, but if there is a requirement - I used this example before, but I refer back to it - for the winter habitat cover for moose, then the knowledge of the nature of the species and how they can trap that snow and how they can hold it, obviously a species that can hold it is better than one that can't and, for this reason, there are certain species that you can identify or stands of those species that you could say are more likely to be used for that purpose, independent of whether they are, by moose, whether the population -- the forester can identify those conditions.

The relationship between soils, the decisions as to the employment of particular practices

and when they are employed, I think I have given quite a few examples here today.

To make a rule and say that provincially or within the area of the undertaking for soils that are -- have some dimension, whether it be depth or thickness, and to say that on those soils only these things shall happen or those things shall happen, I would suggest to you, in the evidence I have given, doesn't make sense. It may be appropriate but in many instances it may not be appropriate.

So that is why I gave the answer to counsel on this one.

MR. FREIDIN: Q. We have heard about the direction which is given to foresters through silvicultural guides.

A. Yes.

Q. And are there examples of a more general type of direction than the one that you are speaking of contained within silvicultural guides?

A. Yes. As a matter of fact on the subject that I was speaking to, on page 14 and on page 15 of the silvicultural guide which is Exhibit No. 382, I believe.

Q. That is Exhibit 382.

THE CHAIRMAN: What page is that again?

MR. ARMSON: Page 14.

MR. FREIDIN: 14.

Q. Yes, Mr. Armson.

A. Yes. I would point out to the Board that this guide and the other guides prepared, that are in preparation and some of which are going to be available other than this one in the near future, that these guides have been prepared by a number of practising foresters from both industry and both government and, therefore, represent that level of knowledge of spruce.

On page 14, if you go to the fourth paragraph you will see that there is a statement there, and if I may read it:

> "The silvicultural ground rules from forest management agreements and Crown management units across the province were examined by the authors to determine common site descriptions used in spruce management."

There has been considerable reference to ground rules and silvicultural ground rules and this is what they were looking at. They then say:

> "Five basic site types were common to many of the ground rules."

And they identify the five there in terms of either shallowness - and they define that in a linear sense in terms of depth or drainage, and then they have organic soils. Immediately beneath those bullet points describing briefly, there is a statement that says:

> "These five sites are too general to be used for detailed prescriptions, however, they do provide a simple basis for common reference throughout Section 3.0 which is titled: Management Prescriptions."

And then they go on to say that they are sometimes described in greater detail.

The point being made here is that these gentlemen have come to the conclusion that there are some broad groupings, but they are making the point that you cannot go beyond that if you are going to the detailed prescriptions which are the sort that one would have at the management unit level.

To the right on page 15 there is a diagramatic grid, if you will, which from -- on the Ontario basis of experience again and in relation particularly in northern region to the Forest Eco-System Classification is a laying out of the relationships -- general relationships as understood or interpreted in terms of both moisture and in terms of

nutrients and these are blocked out in terms of those five broad groupings. So there is -- and you will notice there is some considerable overlap in here.

So what this is providing is that kind of a broad grouping and then recognizing that once you get down to the unit level and the individual stands and situations you have to use this guide, but you then use it to make your decisions on the basis of local knowledge.

MR. FREIDIN: Mr. Chairman, that is the end of a section. I think that would be a convenient place to break.

I can advise you that in terms of the panel -- well, in terms of the evidence, other than the clearcut evidence, I think I have got about maybe a half an hour, maybe, and I believe we can complete the clearcut material on Tuesday and we might even do it before the end of Tuesday. It is hard for me to give you an exact estimate. But we will finish, I am almost certain, on Tuesday.

THE CHAIRMAN: Okay. Will you be ready to go in cross examination -- well, first of all, Mr. Cosman?

MR. COSMAN: Yes, I will, Mr. Chairman. I would -- subject to discussing today's evidence with

my advisors, I would estimate one and two hours.

THE CHAIRMAN: So we can -- if we should finish before say five o'clock on Tuesday, you would be able to start in on Tuesday--

MR. COSMAN: Yes.

THE CHAIRMAN: --rather than having to wait over until Wednesday?

MR. FREIDIN: We are going a full day on Tuesday?

THE CHAIRMAN: Yes, we are going to start at 9:00 a.m. on Tuesday because we are arranging to come in Monday night.

And that may put you on, Ms. Swenarchuk, Wednesday morning. So be ready to go then, if you could.

MS. SWENARCHUK: (nodding affirmatively)

MR. COSMAN: Mr. Chairman, just I think -- did Mr. Freidin say half an hour?

MR. FREIDIN: No, half an hour to finish --

THE CHAIRMAN: Half an hour for the first part and then the clearcut will take him almost the rest of the day, but he might finish...

MR. FREIDIN: No, I am not sure. I really can't give you an exact estimate of how long I

will be on that clearcut material.

THE CHAIRMAN: Okay. But we want to make sure that Mr. Cosman is ready to go after you finish on Tuesday, if you finish early enough.

MR. FREIDIN: Right. But all I am saying is I don't want anyone to take my comments as indicating that there may not be a number of hours left after Mr. Cosman is finished. I just don't know, I can't tell you.

So I am saying, we may get to Ms. Swenarchuk as well. If I finish in the morning - and I might finish in the morning - I can't tell you right now whether I will. That is all.

THE CHAIRMAN: Oh, I am sorry, I misunderstood, are you going to do the clearcut evidence when?

MR. FREIDIN: Tuesday morning. I am going to do the clearcut material....

THE CHAIRMAN: Right after the half hour worth?

MR. FREIDIN: That's right. And I can't tell you whether I am going to be finished at 12:30 or whether I am going to be finished at 3:30 right now.

THE CHAIRMAN: Okay. Well, there is a chance then you maybe ready then for Tuesday as well,

late Tuesday.

We want to try and get as much as we can in next week because we have only got two days.

MS. SEABORN: Mr. Chairman, have you or Mr. Mander had any indication whether there are other counsel other than Ms. Swenarchuk and Mr. Cosman who are going to be cross-examining because that would of course put me after.

THE CHAIRMAN: Well, how long are you going to be Ms. Swenarchuk?

MS. SWENARCHUK: I guess probably between one and two days.

THE CHAIRMAN: You won't be on next week then.

MS. SEABORN: Thank you.

MS. SWENARCHUK: Mr. Chairman, do you have any idea how long we will be sitting on the Thursday?

THE CHAIRMAN: We are not sitting on Thursday.

MS. SWENARCHUK: On Wednesday, rather then?

THE CHAIRMAN: Yes. On Wednesday we will probably be sitting until about three, I would suspect with leaving just enough time -- yes, we are going to

try and sit, I think until about three with leaving just enough time for everybody to make the 5:10 plane going back.

That should leave enough time just to get out to the airport, because the Board and those coming on the site visit have to go back at the end of Wednesday to Toronto and back to Timmins that night.

MS. SEABORN: And, Mr. Chairman, the following week we are starting on Tuesday?

THE CHAIRMAN: Tuesday again.

MS. SEABORN: At nine o'clock.

THE CHAIRMAN: At nine o'clock and we will come in Monday night.

MR. FREIDIN: Oh, we are not sitting...

THE CHAIRMAN: On the Monday we can't sit because of Mr. Armson.

MR. FREIDIN: Right. Okay.

THE CHAIRMAN: Okay, thank you.

MR. FREIDIN: Take it a day at a time, Mr. Chairman.

---Whereupon the hearing adjourned at 1:00., to be reconvened on Tuesday, February 21st, 1989, commencing at 9:00 a.m.

E R R A T A

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10718 - Line No. 10:

For: "Now, the model did prove the effects..."

Please read: "Now, the model did predict the effects..."